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ABSTRACT

Each of the 38 curriculum modules in this packet for agricultural mechanics instruction contains a brief description of the module content, a list of the major divisions or units, the overall objectives, objectives by unit, content outline and suggested teaching methods, student application activities, and evaluation procedures. A listing of resource materials is also included in each module. Module titles are Fundamentals of Ag Engines; Small Engine Overall; Small Gas Engine Service; Lawn and Garden Tractors; Tractor Service; Tractor Engine Tune-Up; Tractor Engine Top Overhaul; Tractor Fuel Systems (Non-Diesel) ; Tractor Engine Ignition System; Tractor Engine Fuel System (Diesel); Tractor Engine Overhaul--Disassembly; Tractor Engine Overhaul--Reassembly; Agricultural Power Trains; Farm Machinery Operation, Maintenance, and Field Repairs; Setting Up Agricultural Machinery; Agricultural Equipment Repairs; Ag Hydraulic Systems; Tillage Equipment; Planting, Spraying and Fertilizing Equipment; Hay and Forage Equipment; Grain Harvesting Equipment; Agricultural Equipment Accessories; Materials Handling Equipment; Lawn and Garden Equipment; Light Earthmoving Equipment Repair and Maintenance; Milking Equipment; Farm Tractor and Vehicle Operation; Tractor Starting and Charging Systems; Planning Agricultural Structures and Service Facilities; Construction and Improvement of Agricultural Structures; Shop Management and Equipment Utilization; Basic Agricultural Welding; Advanced Agricultural Welding; Agricultural Machinery Painting; Planning, Layout, and Fabrication of Custom Equipment; Electrical Fundamentals for Agriculture; Using Electricity in Agriculture; Managing Dealership Parts Department; and Managing an Agricultural Machinery Service Department. (HD)

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MODULES IN AGRICULTURAL EDUCATION

FOR

agricultural mechanics

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Bureau of Occupational and Career Curriculum
Albany, New York 12234

CE 009 326

MODULE OF INSTRUCTION

Title - FUNDAMENTALS OF AG ENGINES Code - 01.0301-01

DESCRIPTION:

This module is to acquaint the student with the various types of internal combustion engines and the interdependence of the component parts. The principles of operation of 2 - and 4 - stroke cycle gasoline and diesel engines will be demonstrated and studied. The module will include the names and functions of parts as well as electrical, fuel, air, exhaust, and cooling system operations. Lubrication will be included and the principle of diesel engines will be explored.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Components of Engines	3	4
2. Two and four cycle sequence	2	2
3. Air, Fuel and Exhaust Systems	2	2
4. Lubrication system	1	1
5. Electrical System	4	4
6. Cooling System	1	1
7. Diesel Principles	1	2
	14	16

Revised June, 1974

MODULE OF INSTRUCTION

Title - FUNDAMENTALS OF AG ENGINES

Code - 01.0301-01

OBJECTIVES to be obtained:

The student will be able to:

1. Identify the major components of a gasoline engine and explain their purposes.
2. State the principles of operation of the two and four cycle gasoline engine.
3. Compare the principles of operation of the two and four cycle gasoline engine.
4. Identify the major components of the fuel, air and exhaust systems and explain the function of the major components.
5. Identify the major components of the lubrication system, trace the flow and explain the function of the major components.
6. Identify the major components of the electrical systems, trace the flow and explain the function of the major components.
7. Identify the major components of the cooling system, trace the flow and explain the function of the major components.
8. State the principles of operation of the two and four cycle diesel engine.
9. Compare the principles of operation of the two and four cycle diesel engine.
10. Identify the major components of a diesel engine and explain their purposes.
11. Compare the major components of a gasoline engine with those of a diesel engine.

01.0301-01

Title - FUNDAMENTALS OF AG ENGINES

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Components of Engines Objective #1 Identify the major components of a gasoline engine and explain their purposes.	A. Stationary components . Cylinder block . Cylinder head . Crankcase - oil pan . Valve cover . Manifolds B. Moving components . Crankshaft . main bearings . Connecting rod and bearings . Piston and rings and wrist pin . Gear train - timing marks . Cam gear and shaft . Push rods - tappets . Rocker arm . Valves, springs, lifters . Flywheel . Governors . Oil pumps

Module FUNDAMENTALS OF AG ENGINES 01.0301-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Class discussion while dismantling small engine. B. Slides, overhead, or film	Students in pairs - dismantle small engine and identify each component by nomenclature	Group discussion- identifying components.
Same as above stationary components 1 & 2.	Same as above	Group discussion identifying components & relating their purpose in a complete engine.

OBJECTIVES BY UNIT	CONTENT
Unit 2 - Two and four cycle sequence Objective #2 Explain the principles of operation of the two and four cycle gasoline engine.	A. Cycles . Intake stroke . Compression stroke . Power stroke . Exhaust stroke B. Valve timing C. Ignition
Objective #3 Compare the principles of operation of the two and four cycle gasoline engine.	A. Cycles . Intake - compression . Power - exhaust B. Scavenging methods . Valving . Porting . Natural & Blower

EDUCATION

Module FUNDAMENTALS OF AG ENGINES 01.0301-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture and utilize the chalkboard, slides or transparencies in discussing the cycles showing for each cycle. • Piston position • Valve position • Point of ignition • Slides or overhead • Engine cutaway B. Hand out sheet showing a, b, & c in above. C. Demonstrate above with small engine.	Using a small engine, each pair of students: . Rotate engine to position for each beginning of each cycle. . note position of piston . note position of each valve . Position engine rotation for: Ignition timing	A. Written or oral test • Listing cycles in sequence • Construct drawings of each cycle showing . piston position . position of valves . point of ignition • Terminologies B. Demonstration by students of above material.
Same procedure used for 4 cycle 1,2 & 3	Same as above for 4 cycle a, b and c.	Written or oral test. (same as for 4 cycle)

OBJECTIVES BY UNIT	**CONTENT**
Unit 3 - Air, Fuel, Exhaust System Objective #4 Identify the major components of the fuel, air and exhaust systems and explain the function of the major components.	A. Air - Exhaust - Systems . Purpose of air cleaners . Types of Air Cleaners . Servicing Procedures (Do's and Don'ts) . Manifolds . water cooled . Turbo chargers - Super chargers . Inter-relationship with the carburetor . Mufflers . Servicing procedures B. Carburetion System . Air-fuel ratio . Carburetors - . up-draft . down-draft . Relationship to intake manifold . Terminologies . Servicing tests and adjustments

EDUCATION

Module FUNDAMENTALS OF AG ENGINES 01.0301-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
Lecture using . Cutaways . Slides or transparencies . Sample engines in shop	A. Familiarize engine manufacturer's specifications on servicing air cleaner. B. Pair students, identify components C. Perform actual service following manufacturer's recommendations.	A. Verbally explain procedure of servicing air cleaner. B. List precautions to take when servicing air cleaner. C. Evaluate students on procedure and final.
A. Lecture - demonstration- dismantling carburetor. B. Slides or overhead C. Cutaways D. Wall charts showing fuel flow.	A. Pair students - dismantle carburetor. B. Identify components by proper name. C. Record manufacturer's specifications from shop manual. D. Perform servicing adjustments and inspections.	A. Explain operation of a carburetor. B. List components and describe their purpose.

OBJECTIVES BY UNIT	CONTENT
Unit 4 - Lubrication System Objective #5 Identify the major components of the lube oil system, trace the flow and explain the function of the major components.	A. Types of system . Splash . Pressure or force feed B. Oil Pumps . Types . Components of . Other accessories - i.e. relief valve, filters, indicator gauges, strainers. C. Crankcase ventilation D. Oil Coolers
Unit 5 - Electrical System Objective #6 Identify the major components of the electrical system, trace the flow and explain the function of the major components.	A. Batteries . Construction of . Principles of B. Magnetos . Types . Principles of operation C. Battery ignition . Components and functions . Circuits . starting . ignition . charging . auxiliary D. Ignition Timing E. Test procedures

EDUCATION

Module FUNDAMENTALS OF AG ENGINES 01.0301-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture Identifying components and operational function. B. Overhead Transparencies C. Slides D. Dismantle & Reassemble pump. E. Wall Oil flow charts.	A. Pair students - dismantle & reassemble. B. Become familiar with manufacturer's tolerances from shop manual. C. Measure wear, determine parts required to replace assembly in serviceable condition.	A. Written test - . List components . Explain operational function of each component . Draw a schematic of a typical system. B. Manipulative on engine . Adjust relief valve to manufacturer's specifications.
A. Lecture - identify components and explain function using - . Cutaway . Wall charts . Disassemble and reassemble components . Transparencies . Shop engine B. Hand out sheets showing components of - . Starting system . Ignition system . Charging system	A. Test battery with hydrometer, volt meter, etc. B. Identify components of a battery in verbal discussion. C. Pair students, disassemble - reassemble and adjust, recommend parts replacement requirement. . Magneto . Distributor . Generator . Starter . Alternators D. Become familiarized with manufacturer's specifications using shop manual as reference and record.	A. Manipulative Test - . Test coil . Test condensor . Set points . Trace electrical circuits on tractor . Install a set of diodes B. Written test - . Explain function of each component. . Draw a schematic of a typical system including starting ignition and charging systems.

OBJECTIVES BY UNIT	CONTENT
Unit 6 - Cooling System Objective #7 Identify the major components of the cooling system, trace the flow and explain the function of the major components.	A. Air Cooled B. Liquid . Gravity or thermo syphon . Pressure or pumped C. Thermostats . Types . bellows . bimetaliic . wax capsule . automatic and hand operated shutters D. Radiator - Hoses - Pressure Cap E. Fan & Shroud F. Water Pump G. Servicing System . Back flushing H. Coolant . Additives
Unit 7 - Diesel Principles Objectives #8, 9, 10 and 11 8. Explain the principles of operation of the two and four cycle diesel engine. 9. Compare the principles of operation of the two and four cycle diesel engine. 10. Identify the major components of a diesel engine and explain their purposes. 11. Compare the major components of a gasoline engine with those of a diesel engine.	A. Principles of Diesel Combustion B. Types of combustion chamber C. Two and four cycle principles D. Diesel Fuels E. Components of fuel system . Transfer pump . types . Fuel filters . types . Injection pumps . types . Injectors . types . Starting aids F. Bleeding the system G. Testing . Fuel pressures . Injector pop-off and spray characteristics H. Turbo charged or supercharged methods.

EDUCATION

Module FUNDAMENTALS OF AG ENGINES 01.0301-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture - demonstration - dismantling and reassembling. B. Slides or Overhead Transparencies C. Wall Charts D. Component cutaways	A. Check thermostat with thermometer and hot water. B. Identify types of thermostats C. Dismantle water pump and recommend components necessary.	A. Evaluate student notes to date. B. Manipulative Test - . Perform a system pressure test. . Identify manufacturer's specifications for above. C. Written test - Draw a diagram showing the flow of coolant through a system. Label the components and define the purpose of each.
A. Lecture Identifying components and operational purpose B. Overhead transparencies C. Slides D. Sample components identifying each. E. Cutaways F. Show proper spray pattern and injection pressure adjustment. G. Hand out sheets showing - . Types of chambers . Types of injection pumps . Types of injectors	A. Identify components on an engine B. Obtain fuel pressures at various locations and check with gauge per specifications. C. Check injector for proper spray and adjust to specifications pressure. D. Bleed a fuel system.	A. Written test - . List components of diesel . Draw diagram of typical fuel system locating components in proper location. B. Compare components with gasoline engine and verbally explain the variations.

MODULE OF INSTRUCTION

Title - FUNDAMENTALS OF AG ENGINES　　Code - 01.0301-01

RESOURCE MATERIALS

A. Books -

1. Tractors and Crawlers - Frazee, Irving and Bedell, Earl L. - Chicago: American Technical Society, 1963.

2. Fundamentals of Service - Engines - Deere and Co., Moline, Illinois - 1968.

3. General Theories of Operation - Briggs and Stratton, 2711 North 13th Street, Milwaukee, Wisconsin 53201

4. Fundamentals of Service - Electrical Systems - Deere and Co., Moline Ill. 1968

5. Principles of Automotive Vehicles - - Department of Army and Air Force TM -9-8000 of Army Tech Manual & TO 36A - 1 - 76 Air Force Training Manual -1956.

B. Bulletins -

C. Periodicals -

D. Audiovisuals -

1. Engine Analysis Visuals - Vocational Agriculture Service AV 203 IMS 434 Mumford Hall, Urbana, Illinois 61801

2. Small Engine Visuals - Vocational Agricultural Service AV 201 IMS 434 Mumford Hall, Urbana, Illinois 61801

3. Fundamentals of Service - Engines - Deere & Co., Slide Set

4. ABC of Internal Combustion Engine - General Motors Corp., Public Relations Staff, Film Library, General Motors Bldg., Detroit, Michigan 48202

5. Working Model - 4-cycle Engine for Overhead Transparency - 3M Company

6. Fundamentals of Service - Electrical Systems - slides - Deere & Co.

MODULE OF INSTRUCTION

Title - SMALL ENGINE OVERHAUL

Code - 01.0301-02

DESCRIPTION:

Mastery of this module will enable the student to do a major overhaul on standard small gasoline engines. He will learn the use of manufacturer's nameplate data such as model and serial numbers to find proper repair and service instructions in manuals and to order the correct replacement parts. The student will learn to determine causes of poor operation and to correct them. This will include the complete teardown of the engine, measuring specifications, replacement of worn or faulty parts, reassembling the engine and adjusting it for efficient operation.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Engine identification	1	1
2. Air cleaners, carburetors, and carburetion	2	4
3. Engine governors	1	2
4. Manual cranking systems		2
5. Magneto ignition systems	2	4
6. Small engine overhaul	2	7
7. Small engine troubleshooting		2
	8	22

Revised August 1975

MODULE OF INSTRUCTION

Title - SMALL ENGINE OVERHAUL Code - 01.0301-02

OBJECTIVES to be obtained:

The student will be able to:

1. Given a small engine, accurately identify the make, model, and specifications of the engine from the identification tag and manufacturers' serial number charts
2. Identify the components of a carburetion system and air cleaner and be able to verbally explain each part's function
3. Identify and orally state the function of the parts of a governing system and replace parts when necessary for the smooth operation of the engine
4. Disassemble and reassemble the windup and recoil cranking systems on a small gas engine and be able to discuss orally the function of the parts of a cranking system
5. Disassemble and reassemble small gasoline engine magnetos. He will be able to test electrical parts and be able to properly adjust and time the magneto to the engine
6. Given a small engine, (under shop conditions) disassemble, check tolerances, service component parts, and reassemble the engine correctly. The engine will be in running condition when students finish the project
7. Given a small engine in running condition, but "bugged" by the instructor, troubleshoot this engine, diagnose and correct the trouble, and put the engine back in good running order according to manufacturers' specifications as judged by the instructor
8. Given a small engine brought into the shop for repair, troubleshoot the engine and get it back in good running order in an allotted time set by the instructor

Code - 01.0301-02

Title - SMALL ENGINE OVERHAUL

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Engine identification Objective 1 Given a small engine, accurately identify the make, model, and specifications of the engine from the identification tag and manufacturers' serial number charts	A. Student use of manufacturers' repair and parts manual
Unit 2 - Air cleaners, carburetors, and carburetion Objective 2 The student will be able to identify the components of a carburetion system and air cleaner and be able to verbally explain each part's function	A. Carburetion theory B. Servicing of various types of air cleaners C. Servicing and adjusting: . Gravity type carburetor . Vacuum type carburetor . Diaphram type carburetor D. Function of: . Throttle . Choke . Idle adjustment screw . High speed adjustment screw . Fuel float . Float needle and seat
Unit 3 - Engine governors Objective 3 The student will be able to identify and orally state the function of the parts of a governing system and replace parts when necessary for the smooth operation of the engine	A. Study of mechanical governors and air vane governors as used on small engines
Unit 4 - Manual cranking systems Objective 4 The student will be able to disassemble and reassemble the wind-up and recoil cranking systems on a small gas engine and be able to discuss orally the function of the parts of a cranking system	A. Wind-up ratchet type starters B. Hand pull starters

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Explain the identification system used by particular manufacturers. (This is explained inside front cover of engine manuals.) B. Show student how to systematically look up parts in a parts manual.	A. Have students identify engines in lab taking model and serial numbers off engine identification plates B. Have students refer to repair and parts book with the identification numbers they have found	Practical test: Instructor will give students a real situation and grade the results Example: Give student an engine to identify and indicate 3 engine parts which need to be replaced (identified in parts book and ordered)
A. Lecture and demonstration to explain principles of operation of carburetor using transparencies or slides. Demonstration of air cleaner service. B. Demonstration showing disassembly of carburetor and location and function of parts.	A. Students will study, clean, and service different types of air cleaners B. Students will disassemble several carburetors, study path of air and fuel, and reassemble C. Students will service carburetor on engines needing repair	Student will lecture and demonstrate with carburetor, explaining carburetion and showing function of parts
A. Demonstrate governor function and linkage to throttle to accomplish engine speed control	A. Investigate engine governing systems on several small engines	Have student explain both a flyball engine governing system and a wind vane governing system
A. Demonstrate mechanical linkage of several mechanical cranking systems B. Show safe procedure when investigating spring loaded devices	A. Investigate the cranking systems of several small engines B. Disassemble, study, and reassemble to find points of wear and other faults	Have students explain cranking principle with parts disassembled

Code - 01.0301-02

Title - SMALL ENGINE OVERHAUL

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Magneto ignition systems Objective 5 The student will be able to disassemble and reassemble small gasoline engine magnetos. He will be able to test electrical parts and be able to properly adjust and time the magneto to the engine.	A. The magneto ignition system . Magneto adjustment air gap . Coil . Condenser . Breaker points . Electrical timing B. Solid state ignition . Diodes . Rectifier . Circuit breakers . Amplifier
Unit 6 - Small engine overhaul Objective 6 Given a small engine, the student will, under shop conditions, be able to disassemble, check tolerances, service component parts, and reassemble the engine correctly. The engine will be in running condition when student finishes the project.	A. Student carefully disassembles

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstrate timing techniques for various types of magnetos (this found in manufacturers' engine manuals) B. Demonstrate use of coil testers, condenser testers, continuity tester, and ohmmeter C. Use testing equipment manuals D. Explain spark plug heat range E. Demonstrate testing and troubleshooting of solid state ignition (write Briggs-Stratton or other manufacturer)	A. Disassemble engine to get at ignition components B. Study ignition parts relationship--students will test parts, condenser, coil, etc. Disassemble and assemble ignition system and run engine C. Student will read manufacturers' material on solid state ignition. He will make recommended tests on a solid state system.	Student will demonstrate testing equipment and replacement of ignition parts on a small engine showing proper electrical timing breaker point gap, air gap, etc.

A. Disassembly (demonstrate)
. Clean work area
. Clean exterior of engine
. Mount on engine mount
. Drain oil
. Remove gasoline from tank
. Remove carburetor and linkage
. Remove muffler
. Remove flywheel nut and flywheel
  . puller method
  . impact nut method
. Remove magneto assembly
. Remove cylinder head and gasket
. Remove valve chamber cover
. Remove valves, springs, and keepers
. Remove base plate or end cover assembly
. Mark connecting rod and cap and remove cap
. Remove cylinder ridge with ridge reamer
. Remove piston and rod assembly
. Remove cam shaft
. Remove crankshaft
. Remove tappets
. Clean all parts for inspection
	A. Student will disassemble classroom engine as follows:
	. Remove:
	  . gas tank
	  . carburetor and linkage
	  . muffler
	  . flywheel nut and flywheel
	  . magneto assembly
	  . valve chamber cover
	  . valves, springs and keepers
	  . base plate or end cover assembly
	. Mark connecting rods and caps
	. Remove:
	  . rods and caps
	  . cylinder ridge and reamer
	  . pistons and rod assembly
	  . cam shaft
	  . crankshaft
	  . tappets
	  . piston rings
	B. Student will disassemble classroom engine and perform the following:
	. Rebore and hone cylinder
	. Measure piston diameter
	. Remove bearings
		The student should be able to disassemble, check tolerances, replace parts, reassemble the engine and properly adjust the engine within the flat rate manual time or to the instructor's satisfaction. All engine malfunctions should have been eliminated during this process.

OBJECTIVES BY UNIT	CONTENT
Objective 6 (continued)	B. Student carefully inspects and measures:

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES

B. Inspect and measure (demonstrate)
. Check cylinder
  . score marks
  . out of round
  . taper and wear
. Deglaze cylinder
. Oversizing cylinder
. Check fit of piston
. Clean thoroughly
. Inspecting bearings
  . tapered
  . ball
  . needle
  . sleeve
. Removal and installation of bearings
. Valve seats
  . grinding
  . lapping
  . insert replacement
  . installing new seats
. Valve guides
  . cleaning
  . measurement
  . replacement
. Valves
  . inspection
  . refacing
  . margin
  . cleaning
. Valve springs
  . test for tension
  . restoring tension
  . valve stem seals
	. Valves
	  . identify faulty valves and seats
	  . check seat contact and face
	  . measure valve seat run-out or out of round
	  . grind (reface)
	  . narrow seats
	  . replace seats
	  . reassemble
	. Valve guides
	  . measure clearance
	  . replace	

. Pistons
  . proper cleaning
  . measuring ring grooves
  . piston clearance
. Piston rings
  . end gap
  . ring depth
  . installation of rings
  . ring compressor
. Connecting rod
  . inspection
  . alignment
  . wrist pin clearance
	. Pistons
	  . measure diameter
	  . remove pins
	  . measure pin fit, skirt clearance
	  . mark and remove
	  . clean
	. Rings
	  . measure groove clearance
	  . re-cut grooves
	  . measure ring end gap
	  . remove
	  . clean grooves	

Code - 01.0301-02

Title - SMALL ENGINE OVERHAUL

AGRICULTURAL

OBJECTIVES BY UNIT	CONTENT

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
. Camshaft . check lobe wear . broken teeth . journal wear . Crankshaft . Cylinder head service . warpage . surface plate check . straight edge check . refacing . Lubrication systems . pumps . splash . scoop . connecting rod oil holes . Breathers . purpose of . types . polyurethane . paper . oil bath . aluminum foil . ram scoop . metal cartridge . fiber element . treated paper element . maintenance of	. Connecting rods . measure clearence . Camshaft . time . measure . Crankshaft . straighteners . time . journal . measure end play and clearance . Measure backlash between cam gear and crankshaft . Head . check for warp . check for cracks . clean . remove ridge	
C. Reassembly . Proper sequence . Torquing where specified . Oil seals		
D. Final adjustments and inspection . Ignition . Carburetion . Air intake . Run in (on dynamometer)	. Identify parts . disassembly and reassembly . Reassembly . check oil seal surface . pistons, rods, etc. . torque, head . establish tappet clearance	

OBJECTIVES BY UNIT	CONTENT
Unit 7 - Small engine troubleshooting Objective 7 Given a small engine in running condition, but "bugged" by the instructor, troubleshoot this engine, diagnose and correct the trouble, and put the engine back in good running order according to manufacturers' specifications as judged by the instructor.	A. Common troubles 2-cycle . Fails to start or hard to start . Engine knocks . Engine misses under load . Engine lacks power . Engine overheats . Engine surges . Engine vibrates B. Common troubles 4-cycle . Fails to start or hard to start . Engine knocks . Engine misses under load . Engine lacks power . Engine overheats . Engine runs unevenly . Engine vibrates . Breather passing oil
Objective 8 Given a small engine brought into the shop for repair, troubleshoot the engine and get it back in good running order in an allotted time set by the instructor.	A. Same as above for Objective 7

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture on use of troubleshooting charts B. Lecture on oil and gasoline mixtures for 2-cycle engines	A. The student studies the "bugged" engine and systematically eliminates trouble spots until he finds the problem.	The student should be able to troubleshoot an engine, determine the malfunctioning cause, and repair the same within flat rate manual time.
	A. When successful, he then tackles an engine which has unknown problems. This is a real troubleshooting situation.	The student should perform an overhaul or a repair job using all test equipment and tools necessary in a workmanlike manner and leave his work area and tools in a clean, orderly condition upon completion of his work.

MODULE OF INSTRUCTION

Title - SMALL ENGINE OVERHAUL Code - 01.0301-02

RESOURCE MATERIALS

Books -

1. Mechanics Handbook - Tecumseh Products Co., Lawson Power Products
2. Small Engine Repair - State Education Department
3. Repair Instructions III - Briggs and Stratton
4. John Deere Service Publications -
5. Theories of Operation Manual
   Repair Instructions II & III Briggs and Stratton
6. Repair Manual - Tecumseh Products Co.
7. Small Gasoline Engines Training Manual - Ted Pipe
8. Small Engines Care Operation and Repair - Volume I and II - AAAE & VA available from IMS. Repair manuals often can be obtained free from supply stores.

Audiovisuals -

1. "Condensers and Points" - Slide set #17 - Briggs and Stratton
2. "2-cycle Engines" - Slide set #690141 - Tecumseh Products Co.
3. "Complete Overhaul: - Slide set - Briggs and Stratton
4. "Resizing Cylinders" - Slide set - Briggs and Stratton
5. "Valve Seat Reconditioning" - Slide set - Briggs and Stratton
6. "Valves and Retainers" - Slide Set - Briggs and Stratton
7. Ken Cook Transnational, 9929 West Silver Spring Road, Milwaukee, Wis. 53225

SMALL ENGINE CHECK SHEET #1 NAME______________________________

ENGINE IDENTIFICATION

PART	ACCEPTABLE SPECIFICATION	ACTUAL MEASUREMENT
CRANKSHAFT		
magneto journal		
crankpin		
pto journal		
CAMSHAFT		
journals		
lobes		
BEARINGS		
main pto		
main magneto		
CYLINDER PISTON		
cylinder out of round		
piston skirt		
piston pin		
rod crankpin		
piston pin bearing		
ring end gap		
ring side gap		

Circle parts that need to be replaced and write out an order for the parts.

SMALL ENGINE OVERHAUL

Given a small engine the student will demonstrate his ability to do the following:

1. Accurately identify the make, model, and specifications of the engine from the identification tag and manufacturers serial number charts.
2. Use a micrometer, telescoping gauge, small hole gauge and calipers to correctly measure parts for which specifications are given.
3. Perform the following on an engine in need of repair:

    ____ face valves
    ____ grind valve seats
    ____ check valve springs
    ____ set valve tappet gap
    ____ check crankshaft & play
    ____ hone cylinder
    ____ install rings
    ____ clean & assemble carburetor
    ____ adjust carburetor
    ____ set armature air gap
    ____ set points & plug gap

4. The engine will run correctly after it has been overhauled.

Instructor's Evaluation

Name ____________________

Date Completed ____________________

MODULE OF INSTRUCTION

Title - SMALL GAS ENGINE SERVICE Code - 01.0301-03

DESCRIPTION:

This module deals with the servicing and maintenance of small gas engines, including the initial servicing of a new engine, maintenance in regular use, and preparation for storage. Both 2 - and 4 - stroke cycle engines will be included. The student will learn to determine the causes of the more common operating troubles, and to correct them. Another module will deal with the more serious malfunctions and repairing of small engines.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	 Other
1. Engine fundamentals	2	1
2. Servicing new small gas engines before use	1	2
3. Maintaining and regular servicing of small gas engines	2	8
4. "Troubleshooting" and making minor repairs to small gas engines	3	8
5. Off-season storage of small gas engines	1	2
	9	21

Revised June 1974

MODULE OF INSTRUCTION

Title - SMALL GAS ENGINE SERVICE

Code - [illegible].0301-03

OBJECTIVES to be obtained:

The student will be able to:

1. State the operational theory of a two cycle and a four cycle engine.
2. Perform pre-delivery service on a new small gasoline engine according to manufacturers specifications.
3. Correctly service and check out a used small gas engine according to manufacturers specifications and flat rate time allocation.
4. Troubleshoot a small gasoline engine which is operable but "bugged" by the instructor and make it run properly within a time satisfactory to the instructor.
5. Correctly service a small gas engine for storage according to manufacturers specifications.

Code - 01.0301-03

Title - SMALL GAS ENGINE SERVICE

OBJECTIVES BY UNIT	CONTENT
Unit 1. Engine Fundamentals Obj. 1. The student will explain the operational theory of a two cycle and a four cycle engine.	A. Operation of single cylinder air cooled engine . 4 stroke cycle engine . Compression . Carburetion . Ignition . Cooling system . Governors . 2 stroke cycle engine . Compression . Carburetion . Ignition . Exhaust B. Application of 2 stroke cycle and 4 stroke cycle engines . Chain saws . Snowmobiles . Outboards . Golf carts . Lawn and garden equipment . Generators . Pumps . Motorcycles . Power units
Unit 2. Servicing new small gas engines before use. Obj. 2. Pre-delivery service on a new small gasoline engine according to manufacturers specifications.	A. Fuel-oil mixtures for 2 stroke cycle engines . Amount of oil to add to fuel . Kinds of oil to add . Manufacturer's recommendation B. Checking oil levels in 4 stroke cycle engines C. Break-in period for new engines or overhauled engines.

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Cover essential information in engine fundamentals to give students a basic knowledge of how an engine operates. B. Overhead projection of engine parts and operation of 2 stroke cycle and 4 stroke cycle. C. Demonstrate: . How compression is checked . How carburetor is adjusted . How ignition is checked . How governor operates and linkage adjusted	The student will use laboratory engines (4 stroke and 2 stroke cycle) and run compression tests, ignition tests and adjustments to carburetor and governor.	Written or oral test on engine fundamentals
A. Lecture on oils, additives, and fuels. B. Overhead projections. C. Demonstration on mixing fuel and oil together. C. Slides	A. Students to look up manufacturers specifications on fuel-oil mixture and mix fuel for a 2 stroke cycle engine. B. Students to mix improper fuel-oil mixture (with caution) and observe malfunctions caused by careless fuel oil preparation. C. Students correctly adjust cable controls and linkages.	A. The student will correctly pre-service a small gas engine according to the manufacturers specifications identified in the service manual for that engine. B. Instructor and students will check procedure and completed project.

Code - 01.0301-03

Title - SMALL GAS ENGINE SERVICE

OBJECTIVES BY UNIT	CONTENT
Unit 3. Maintaining and regular servicing of small gasoline engines Obj. 3. Correctly service and check out a used small gas engine according to manufacturers specifications and flat rate time allocation.	A. Maintenance practices for lubrication . Dippers . Slingers . Pumps B. Cooling system . Manual C. Starting system . Manual . Electric D. Carburetion system . Fuel . Air cleaners . Fuel filters . Tanks and hoses
Unit 4. "Troubleshooting" and making minor repairs to small gas engines. Obj. 4. Troubleshoot a small gasoline engine which is operable but "bugged" by the instructor and make it run properly within a time satisfactory to the instructor.	A. Diagnosing common troubles: . Engine won't start . Engine hard to start . Engine lacks power . Engine vibrates . Engine overheats . Engine knocks . Engine surges

EDUCATION

01.0301-03 - Code

SMALL GAS ENGINE SERVICE - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture-lubrication systems and cooling system. B. Demonstration-servicing and cleaning different types of air cleaners. C. Show various systems of lubrication. D. Slide series on Maintenance E. Demonstrate types of starting systems. F. Demonstrate adjusting various types of carburetors G. Follow service charts in owners manuals.	A. Students will change oil in small engine, clean the cooling system, clean the air cleaner both oil bath and dry type, adjust a carburetor and otherwise service a used engine according to manufacturers recommendations.	A. The student will correctly service a used small gas engine during a flat rate time set by the instructor. B. Instructor and students will check procedure and completed project.
A. Overhead projections B. Charts on suggested remedies for each trouble indicated. C. Demonstrate engine with "bugged" malfunctions and show how you eliminate possibilities to arrive at the probable cause of the malfunction. D. Point out necessary ingredients for engine operation: . Air . Fuel . Ignition . Compression . oil . valves	A. Students will work on engines with (malfunctions built in "bugged") and will encounter simple and progressively more complex problems.	A. The student will troubleshoot a small gas engine that has been "bugged" by the instructor and will find the trouble and have engine running within time limit set by the instructor. The instructor will oversee the procedure.

OBJECTIVES BY UNIT	CONTENT
Unit 5. Off-season storage of small gas engines. Obj. 5. Correctly service a small gas engine for storage according to manufacturers specifications.	A. Recommended practices for storage . Emptying gas tank, carburetor fuel lines . Care of cylinder . Changing oil . Cleaning cooling system . Fogging crankcase, carburetor fuel tanks, fuel lines and metal parts on engine

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Slide Series on Storage B. Demonstrate proper practices with use of small engine C. Discuss reasons for these practices. D. Discuss type of oil to use for fogging and storage.	A. The students will work on engines in need of offseason service, readying them for winter or summer storage following manufacturers recommendations.	A. The student will correctly service a small gas engine for storage according to manufacturers service manual. The instructor will oversee procedure.

MODULE OF INSTRUCTION

Title - SMALL GAS ENGINE SERVICE Code 01.0301-03

RESOURCE MATERIALS

Books - Small Engine Repair - The University of the State of New York., State Education Dept.

Mechanics Handbook - Tecumseh Products Co.

The Two Cycle Engine - McCulloch Corp.

Appropriate Manufacturer's Manuals

Repair Manual - Briggs and Stratton

Theories of Operation Manual - Briggs and Stratton

Audiovisuals -

Slide Series on Storage - Briggs and Stratton

Slide Series on Maintenance - Briggs and Stratton

Slide Series on Pre-delivery Service - Briggs and Stratton

Overhead masters on Small - I.M.S., Cornell University

MODULE OF INSTRUCTION

Title - LAWN AND GARDEN TRACTORS Code - 01.0301-04

DESCRIPTION:

Before delivery or operation of a new garden tractor, it should be properly assembled, serviced, and its performance checked. Students will learn proper assembly, fueling, and lubricating as well as the checking of safety devices and operation. The students will perform the required maintenance service, routine repairs, and operating adjustments on both new and used tractors.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Assembly and Pre-Delivery Service	2	6
2. Safety Rules and Tractor Operation	1	2
3. Fuels, Lubricants, Lubrication and Maintenance Service	2	8
4. Troubleshooting	1	5
5. Preparing Tractor for Storage	1	2
	7	23

Revised June, 1974

MODULE OF INSTRUCTION

Title - LAWN AND GARDEN TRACTORS

Code - 01.0301-04

OBJECTIVES to be obtained:

The student will be able to:

1. Given a new tractor, follow the manufacturers recommended procedure, assemble and perform seven specific pre-delivery service operations.

2. Operate the tractor for the break-in period, establish rules for safe operation and at the same time check completely for any malfunction in the tractor operation.

3. Given a used tractor, perform a systematic maintenance service and repair according to manufacturers specifications including:

   - . Check and maintenance of fuel system
   - . Care and replacement of V-belts
   - . Adjusting brakes
   - . Adjust carburetor
   - . Service electrical system
   - . Adjust P.T.O. clutches
   - . Adjust steering mechanism
   - . Maintain hydraulic system

4. Identify engine and tractor malfunctions and will be able to diagnose and remedy the problems.

5. Prepare a tractor for storage.

Title - LAWN AND GARDEN TRACTORS

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Assembly and Pre-delivery Service Objective #1 Given a new tractor, the student, following the manufacturers recommended procedure, will assemble and perform seven specific pre-delivery service operations.	A. Install steering wheel B. Install seat C. Install tires D. Check engine crankcase oil level E. Add electrolyte to battery and charge F. Install battery G. Check hydraulic fluid level H. Fill gas tank I. Check transmission oil level J. Check tire inflation K. Adjust front wheels for toe in and alignment L. Check safety shields and safety warning markers M. Lubricate all fittings
Unit 2 - Safety Rules and Tractor Operation Objective #2 The student will operate the tractor for the break in period, establish rules for safe operation and at the same time check completely for any malfunction in the tractor operation.	A. Safe tractor operation B. Break in operation of tractor C. Tractor controls - . Clutch brake . Speed control . Shift lever . P.T.O. . Lift lever . Ignition switch . Ammeter . Choke . Pre-starting inspection

01.0301-04 - Code

LAWN AND GARDEN TRACTORS - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstrations - on cutting crating landing straps and unpacking tractor. B. Lecture-on reporting damaged goods during shipment to company. C. Notes - students wear safety face mask when handling electrolyte and battery, then wash hands. D. Demonstrate - how to lift or jack tractor up for working on and where to place jack stands for safety. E. Notes - see owners manual for type of fluid. F. Notes - use straight edge and ruler. G. Follow operators manual. Discuss results of improper break-in.	A. The student will completely assemble and perform pre-delivery service on a small tractor according to manufacturers recommendation.	A. The student will completely assemble and perform pre-delivery service on a small tractor according to manufacturers recommendations. B. Instructor will check procedure.
A. Demonstrate-areas of danger on tractor. B. Demonstrate-limits of machine for the job it was designed. C. Lecture-on dealers job of explaining safe operation to his new customers. D. Cover motor vehicle laws concerning operation in highways E. Explain how misuse affects tractor warranties. F. Demonstrate-safety starting device on some clutch pedals and pedal position for breaking and brake lock. G. Demonstrate-setting for various attachments and safe operation H. Demonstrate-gear selection on standard shift models. Demonstrate operation and principles of hydraulic devices. I. Demonstrate-correct engagement of PTO and lift levers. J. Demonstrate-raising and lowering on each tractor model available.	A. The student will read warranty regulations and will become familiar with the tractor operators manual.	A. The student will orally give safety rules and will demonstrate tractor operational proficiency to instructor.

OBJECTIVES BY UNIT	CONTENT

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Continued from previous page K. Show - how to start and stop the engine. L. Explain function and normal readings under operation. M. Demonstrate-on carburetor how the choke works. Explain when necessary to use. Follow owners manual.		

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Fuels, lubricants, lubrication and maintenance service Objective #3 Given a used tractor, the student will perform a systematic maintenance service and repair according to manufacturers specifications, including: . Check and maintenance of fuel system . Care and replacement of V-belts . Adjusting brakes . Adjusting carburetor . Service electrical system . Adjust P.T.O. clutches . Adjust steering mechanism . Maintain hydraulic system	A. Type of fuel used. B. Seasonal lubrication requirements C. Transmission fluids D. Daily lubrication service . Check engine crankcase level . Check flywheel screen E. Weekly or service at 25 hours . Change engine oil . Check hydraulic system, change filter . Breather . Check battery . Check drive belt tension F. 100 hours of operation . Clean engine shrouds . Repeat 5 and 25 hour service checks . Clean spark plugs G. Each spring and fall season . Clean fuel strainer . Lubricate grease fittings . Check breaker points H. Every two years . Change transmission oil . Check hydraulic fluid level I. V-Belt care and maintenance . Cleaning V-Belts . Adjusting V-Belt tension . Replacing belts . Adjusting brakes J. Fuel system . Cleaning fuel strainer . Adjusting carburetor K. Electrical system . Clean battery . Check battery water level . Servicing breaker points and plug gaps L. Adjusting power take-off clutch M. Adjusting PTO clutch brake N. Steering adjustments . Adjusting steering cone . Adjusting steering gear . Servicing transmission . Adjusting clutch and brake O. Hydraulic system . Cleaning breather . Lift lever adjustments . Changing hydraulic fluid

01.0301-04 - Code

LAWN AND GARDEN TRACTORS - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Explain fuel ratings B. Explain various grades of grease and oils and their specific designed use. C. Film on oils and lubricants. D. Discuss manufacturers recommendations. E. Use slides to show engine wear from dirty oil. F. Cut away a badly worn engine for demonstration. G. Carburetor float level demonstration using gauge or ruler. H. Demonstrate using a tachometer. I. Demonstrate ignition system adjustment. J. Demonstrate use of feeler gauge, dwell meter and sparkplug feeler gauge. K. Demonstrate following manufacturers recommendations. L. Demonstration cleaning hydraulic system. M. Follow manufacturers specifications. N. Students wear safety goggles if using air.	A. The student will work with a tractor operators manual and shop repair manual and will make all necessary checks to put tractor in proper running order.	A. The student will be supervised in his projects and his progress graded.

Title - LAWN AND GARDEN TRACTORS

OBJECTIVES BY UNIT	CONTENT
Unit 4 - Troubleshooting Objective #4 The student will identify engine and tractor malfunctions and will be able to diagnose and remedy the problems.	A. Starter will not turn engine. B. Hard starting C. Engine missing under load D. Loss of engine power E. Engine will not idle F. Transmission will not stay in gear G. Brakes do not work H. Improper steering I. Clutch hard to operate J. Hydraulic system inoperative
Unit 5 - Preparing tractor for storage. Objective #5 The student will prepare a tractor for storage.	A. Engine preparation B. Tractor preparation C. Preparing tractor for use after storage.

EDUCATION

01.0301-04 - Code

LAWN AND GARDEN TRACTORS - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstration. B. Discussion. C. Show students how to use repair manuals.	A. The student will work with problem situations on tractors and engines.	A. The students progress on these projects will be graded by instructor.
A. Demonstrate method. B. Discussion on rust preventive oils to use. C. Follow manufacturers recommendations.	A. The student will prepare a tractor for storage.	A. Student will be graded on his procedure and on final preparation job.

MODULE OF INSTRUCTION

Title - LAWN AND GARDEN TRACTORS Code - 01.0301-04

RESOURCE MATERIALS

A. Books - Small Tractor Service Manual. Interec Publishing Co., 1014 Wyandotte St. Kansas City, Mo. 64105.

Small Engine Service Manual. Interec Publishing Co.

Small Engines, care, operation, maintenance, and repair. Volumes 1 & 2 American Association. Athens, Georgia.

B. Periodicals -

Lawn Equipment Journal. Quinn Publications, 3339 West Freeway, Fort Worth, Texas 76100.

Farm Power Garden. New York State Farm Equipment Dealers Association, Hamilton, New York 13346.

Farm Power and Equipment. NRFA Publications, Inc. 2340 Hampton Ave., St. Louis, Mo. 65251.

Implement and Tractor. Interec Publishing Co., 1014 Wyandotte St., Kansas City, Mo. 64105.

C. Audiovisuals -

Oils and Lubrication Slides - Pennoil Co., Syracuse, New York

MODULE OF INSTRUCTION

Title - TRACTOR SERVICE   Code - 01.0301-05

DESCRIPTION:

The purpose of this module is to develop the student's ability to properly service a tractor. This service procedure consists of proper care and maintenance from the time a unit is purchased from a dealership to the day the unit is traded in, sold or junked. It will include daily and periodic servicing of the chassis, engine, power train, hydraulic system and other accessories. It will also involve the student in maintaining a service record of vehicles. This maintenance procedure will utilize as guides, manufacturers owners and service manuals. As a result, the student will be capable of performing the actual service in addition to maintaining service records on agricultural tractors.

DIVISIONS OR UNITS OF CONTENT	Time Allocation	
	Class	Other
1. Maintenance Record Form	1	1
2. Chassis	1	2
3. Lubrication	2	4
4. Air Induction System	1	1
5. Cooling System	1	1
6. Electrical System	3	6
7. Fuel System	1	2
8. Other Systems	1	2
	11	19

Revised June, 1974

MODULE OF INSTRUCTION

Title - TRACTOR SERVICE Code - 01.0301-05

OBJECTIVES to be obtained:
The student will be able to:

1. Recognize the importance of daily and periodic maintenance and will set up a maintenance chart to use on a tractor(s) at home.

2. Identify the locations of adjustments on the chassis, recognize the adjustments per manufacturers specifications and make required adjustments or replacements.

3. Identify the lubrication points on a tractor, select the proper lubricant, and perform the periodic required lubrication maintenance.

4. Identify the servicing required to the air induction system and perform the required procedure per manufacturers recommendations.

5. Identify the servicing requirements of the cooling system and perform the required procedure per manufacturers recommendations.

6. Identify the servicing requirements of a tractor electrical system per recommendations and perform requirements.

7. Identify the required servicing of a fuel system per recommendations and perform required service.

8. Identify other required service concerning the engine, tin ware and hydraulic systems not covered in other seven objectives and perform recommended procedures.

Code - 01.0301-05

AGRICULTURAL

Title - TRACTOR SERVICE

OBJECTIVES BY UNIT	CONTENT
Unit 1. Record Form Obj. #1. The student will realize the importance of daily and periodic maintenance and set up a maintenance chart.	A. Reasons for maintenance program . Reduce overhead . Increase tractor life . Prevent breakdown during crucial times . Reduce down time of tractor B. Maintenance recordkeeping . Forms . Manufacturer specifications or recommendations . how to use specifications . where to find specifications . Suggestions for . starting a library of information
Unit 2. Chassis Obj. #2. Identify the locations of adjustment on the chassis, recognize the adjustments per manufacturers specifications and make required adjustments or replacement.	A. Tire care B. Wheel bearing adjustment C. Front end toe-in D. Throttle linkage adjustment E. Governor adjustment F. Clutch adjustment G. Foot brake adjustment and interlock H. Steering sector adjustment I. Differential lock adjustment J. Wheel tread width adjustment K. Tractor accessories available . Vertical-horizontal muffler . Front end weights . Rear wheel weights . Dual wheel . Draw bar variables . Belt pulley . 3 point link stabilizers L. Tighten all cap screws,bolts,screws periodically

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Compare costs of proper maintenance, vs haphazard method . Charts . Actual records B. Charts, slides, transparencies . Sample forms . Owners manuals and shop manuals published by the manufacturer . Review manuals for specifications.	A. Each student develop own form. B. Each student keep maintenance record on one or more vehicles used on a farm. C. List periodic maintenance in chronological order.	A. Evaluate student's records maintained on farm vehicle for completeness, accuracy and service required in chronological order.
A. Using owners manuals of a manufacturer of a specific model tractor. Assign one to each student. B. Discuss adjustments, procedures and recommendations for the general characteristics of the job the tractor is to be used for.	A. Using the student designed maintenance record form . Locate all adjustments and record. . If specific periodic hours - record. B. Same as A. but have student use manual on own tractor.	A. Evaluate students progress obtaining adjustments and recommendation. B. Evaluate same. C. Assign any manual of any make tractor and have student find the manufacturers recommendation for each item in content of this objective.

OBJECTIVES BY UNIT	CONTENT
Unit 3. Lubrication Obj.#3. Identify the lubrication points on a tractor, select the proper lubricant for each location, and perform the periodic lubrication maintenance.	A. Fuels and lubricants B. Locate all pressure type grease fittings and lubricate C. Check and change engine oil and filter D. Check and change transmission oil E. Check and change differential F. Cleaning magnetic drain plugs G. Servicing crankcase breather H. Servicing oil pump screen I. Check and change power steering oil and filter J. Check and change rear axle planetary or drop housings K. Check and change steering housing L. Lubricate generator M. Check and lubricate front wheel bearings N. Precautionary measures or safety procedures.
Unit 4. Air Induction System Obj.#4. Identify the servicing required to the air induction system and perform the required procedure per manufacturers recommendations.	A. Components of air induction system B. Purpose of air filters C. Types of air cleaners .Oil bath .Dry element D. Service recommendations . Oil bath . Dry element . Precautionary measures E. Visual inspection of duct work .Importance of observation

01.0301-05 - Code

TRACTOR SERVICE - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Using a specific tractor and its owners manual discuss the items listed under content of this objective. B. Actual procedure followed on a live tractor per manufacturers recommendations.	A. Select proper lubricant for each lubrication location per manufacturer recommendations from owners manual. B. Perform each servicing procedure outlined under content of this objective. C. Have students bring in for comparison various suppliers fuels and lubricant specifications with manufacturers recommendations. D. Select proper lubricant from supplier specifications to use at each location listed under content of this objective.	Oral or written: A. Have student record the lubricant for each location. B. Observe servicing procedure. C. Use a manual of any tractor. Have student locate manufacturers recommendation and record for each item under content of this objective.
A. Use charts, air cleaners manufacturers literature, cutaways of air cleaners, discuss how an air cleaner works, its importance and various types. B. Use slides, transparencies or actual components showing . Comparison of internal engine components of proper and improper air induction servicing. C. Actual cleaning of a dry element . Air . Washing . Precautionary measures	A. Perform actual service of . Oil bath . Dry element B. With tractor assigned or unit at home - actually perform or list recommendations concerning . Hours of service intervals . Type of service required . Precautionary measures	Written or oral A. Assign a manual of any tractor to each student. Have him describe the servicing procedure, hour intervals, and precautionary measures for items 3, 4 and 5 under content of this objective.

Code - 01.0301-05

Title - TRACTOR SERVICE

A G R I C U L T U R A L

OBJECTIVES BY UNIT	CONTENT
Unit 5.Cooling System Obj.#5. Identify the servicing requirements of the cooling system and perform the required procedures per manufacturers recommendations.	A. Components of a cooling system B. Purpose of a cooling system C. Properly drain a cooling system D. Flushing or cleaning a cooling system E. Types of cooling agents (anti freeze) .Strength of anti freeze for proper protection F. Checking the thermostat G. Checking the pressure cap H. Use of rust inhibitors I. Importance of shutters and/or air shrouds J. Radiator service (external) . Free from debris . Free from oil and dirt accumulation K. Coolant heaters for cold weather starting aid L. Importance of grille screens M. Winter storage procedure N. Visual check . Hoses . Fan belt . Ever flow tube obstructions O. Adjust fan belt w/ proper deflection

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture using charts, cutaways, transparencies and actual components, discuss all items under content of this objective. B. Demonstrate jobs mentioned in content of this objective. C. Visually check an actual unit for oil and fuel leaks causing collection of dirt causing poor cooling. D. Recommend steam cleaning.	A. Using an owners manual for an assigned tractor or one at home locate and record requirements of the cooling system following items #3, 4,5,6,7,14 and 15 in content of this objective.	Written or oral A. Assign any manual to the student, locate and record cooling system requirements in items #3,4,5,6,7, 14, and 15 of the content of this objective.

Code - 01.0301-05

Title - TRACTOR SERVICE

OBJECTIVES BY UNIT	CONTENT
Unit 6. Electrical System Obj.#6. Identify the servicing requirements of a tractor electrical system from the owners manual and perform the required procedures per the manufacturers specifications.	A. Purpose of the electrical system B. 4 major circuits of the electrical system C. Battery checks, maintenance and tests D. Visually check all wiring for loose connections, bare wires, corrosion E. Starting procedure . Cold weather F. Restrictions on use of starter G. Electrical schematic diagram H. Generator condition I. Starter condition J. Check and test regulator
Unit 7. Fuel System Obj.#7. Identify the servicing recommendations of a tractor fuel system from the owners manual and perform the required procedures.	A. Diesel fuel system . Filter change . Clean sediment bowl . Bleeding the fuel system . Clean screens . Change fuel filters . Lines B. Gasoline fuel system . Sediment bowl . Fuel screens . Carburetor adjustments C. Fuel-general . Fuel tank cap . Safety precautions filling tank . Importance of cleanliness
Unit 8. Other Systems Obj.#8. Identify additional service required other than the 1-7 objectives. (miscellaneous)	A. Adjust engine valves B. Adjust governor C. Adjust throttle linkage D. Visual check of tin ware E. Seat position for operator F. Safety precautions hitching, towing G. Adjust hydraulic control linkage H. Check hydraulic working pressure of power steering and 3 point system

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture - using slides, strip film, transparencies and hand out sheets. . Components of the electrical system. . Purpose of components. . Daily and periodic maintenance to electrical system. B. Physically check on a tractor. . Conditions of the electrical system wiring and connections. . Generator brushes and armature condition. . Starter brushes and armature condition. . Make actual checks on . battery . charging system . starting system C. Lecture using actual tractor, slides, transparencies and hand out sheets . Cold weather starting procedure (diesel) . Safety measures using starter and restrictions.	A. Identify components of the electrical major circuits on an assigned unit. B. Using the owners manual for the assigned unit, identify the daily checks of the electrical system. C. Change brushes and clean up armature on an assigned unit also test the components. D. Change brushes and clean up armature on assigned unit and test the components. E. Using the schematic diagram of the electrical system, trace major circuits. F. Install a set of ignition points and condensor. G. Check ignition timing.	A. Written or oral - Assign any manual to each student, locate or record the electrical system recommendations for daily periodic servicing.
A. Lecture using owners manuals, discuss the requirements concerning the fuel system. B. Using actual tractor and perform . Filter change . Sediment bowl cleaning . Bleeding a diesel system . Physically check lines for leaks C. Lecture, slides, charts, cutaways actual component. . Discuss carburetor principles. . Carburetor adjustment . Dismantle a carburetor	A. Identify from owners manual required service and hours for service. B. Bleed a diesel fuel system. C. Change fuel filters. D. Check fuel tank cap for breathing. E. Dismantle carburetor and adjust on tractor engine. F. Make visual checks.	A. Assign a carburetor to each student. Record adjustments and actually make adjustments.
A. Manipulatively - . Adjust items listed in content per owners manual items #1,2,3,7and 8.	A. Perform all items listed under content items #1,2,3, 7 and 8.	A. Manipulative test - Adjust valves on an engine. B. Adjust the governor. C. Take relief pressure of hydraulic and power steering.

MODULE OF INSTRUCTION

Title - TRACTOR SERVICE Code - 01.0301-05

RESOURCE MATERIALS

Books:

1. Tractor Maintenance - Principles & Procedures
   Am.Assoc. For Voc. Inst.
   Materials Engineering Ctr., Athens, Georgia 30601

2. 4-H Tractor Maintenance Units 1-4

3. Tractor Owners or Operators Manual for Any Model or Make used:
   Examples: Massey Ferguson Inc., 12601 Southfield Rd., Detroit, Mich.
   Owners Manual 690-435M1 for MF65 tractor.

Audio
Visuals:

Film Strip - Tractor Maintenance - Principles & Procedures
Am.Assoc. for Voc. Inst. Material - Engineering Center.
Athens, Georgia 30601

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE TUNE-UP

Code - 01.0301-06

DESCRIPTION:

The student will develop an effective, systematic procedure to follow in "checking out" a tractor engine, and will learn the technical knowledge and abilities necessary to make the needed adjustments. He will gain experience in the use of electronic test equipment, the operation and use of a dynamometer for determining the malfunction and inefficiency of the engine. Tests and adjustments will be made to the air, exhaust, ignition, fuel, lubrication, cooling and electrical systems.

DIVISIONS OR UNITS OF CONTENT	Time Allocation	
	Class	Other
1. Introduction to Tune-Up	1	3
2. Visual Inspection	1	3
3. Dynamometer Test	1	3
4. Tune-Up Procedures	4	14
	7	23

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE TUNE-UP

Code - 01.0301-06

OBJECTIVES to be obtained:

The student will be able to:

1. Define, to the instructors' satisfaction, the term "tune-up".
2. Identify four reasons for tuning-up an engine.
3. Describe the economic importance of a properly tuned engine.
4. Using a tractor, perform visual inspection-listing the necessary adjustments to be made.
5. Clean a tractor, using a steam cleaner, so that a complete visual inspection is possible.
6. Correctly use the dynamometer on a tractor that is to be tuned.
7. Perform a dynamometer check on a tractor and record the test results.
8. Fill out and complete work order on air and exhaust system of tractor.
9. Perform a vacuum test, compression test, torque head bolts and adjust valves to manufacturer's specifications.
10. Check, adjust and/or correct problems in ignition system.
11. Check, adjust and/or correct problems in fuel system.
12. Check, adjust and/or correct problems in lubrication system.
13. Check, adjust and/or correct problems in cooling system.
14. Check, adjust and/or correct problems in electrical system.

OBJECTIVES to be obtained:

(continued)

15. Check, adjust and/or correct malfunction in clutch pedal controls.

16. Perform final dynamometer test to prove adjustments have restored engine efficiencies.

Code - 01.0301-06

Title - TRACTOR ENGINE TUNE-UP

OBJECTIVES BY UNIT	CONTENT
Unit 1 Introduction to tune-up Objective 1 Define , to the instructors' satisfaction, the term "tune-up"	A. What is tune-up . Checks for malfunctions . Minor adjustments . Preventive maintenance
Objective 2 Identify four reasons for tuning-up an engine.	B. Why tune-up . Catch problems early . Prevent power loss . Decrease fuel consumption . Overcome difficulty in starting . Overheating eliminated
	C. When to tune-up . Regularly . 250 hrs, 500 hrs, 1,000 hrs. . Seasonally
Objective 3 Describe the economic importance of a properly tuned engine.	D. Results of a tune-up . Studies show - . 11% HP increase . 14% fuel efficiency increase . 5.3% increase in power through resetting ignition . dependable for long, productive hours

01.0301-06 - Code

TRACTOR ENGINE TUNE-UP - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Obtain and assemble references from as many manufacturers' service departments as possible.	A. Study references provided and data obtained from the various sources available.	A.- B. Written and/or oral exam on definition of tune-up
B. Refer to reference list at the end of this module and review information that is available from the colleges in the form of bulletins, the various periodicals, etc. and the audio-visuals.	B. Develop graphs from this data and information to illustrate the values of savings, etc.	
C. Have students develop graphs showing performances of properly adjusted tractors as compared with tractors not properly adjusted.	C. Observe the procedures demonstrated by the instructor in obtaining the data so that you will be able to perform the same tests on other tractors.	C. Written or oral description of the factors involved in the comparison of a tuned and an untuned engine. Problem solving techniques with an actual tractor as given on paper as a report.
D. Demonstrate by use of a gasoline flow meter the difference in fuel consumption when the tractor engine is properly timed and not timed, also when the carburetor is properly adjusted and not adjusted.	D. List the factors and calculations given by the instructor or guest service manager from local dealership for future reference and use.	
E. Have a local dealer's service manager bring to the class the past month's service records of customers to illustrate a comparison of the average cost of tune-up and maintenance and the total value of the equipment that was serviced. Have him point out the savings that could have been made by more timely tune-up.		

OBJECTIVES BY UNIT	CONTENT
Unit 2 Visual Inspection Objective 4 Using a tractor, perform the visual inspection, listing the necessary adjustments to be made. Objective 5 Clean a tractor using a steam cleaner so that a complete visual inspection is possible.	A. Checks to be made . Air Intake System . air leaks . restrictions . Oil and Water Leakage . Electrical System . battery . cables . wiring . indicator light . Cooling system . water in crank case . external leaks . clogging . Fuel System . leaks . restrictions . clogged filter . Steam Clean . improves cooling . easier to spot troubles . simpler to tune-up
Unit 3 Dynamometer Test Objective 6 Correctly use the dynamometer on a tractor that is to be tuned. Objective 7 Perform a dynamometer check on a tractor and record the test results	A. Purpose - . As -is condition . Determine - . simple tune-up . need for overhaul . Procedure - . connect to tractor . operate at half load for 30 min.-temp. normal . gradually increase load to rated load speed . read HP on dynamometer . compare HP with technical manual . Analyze results

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Explain and demonstrate the visual inspection pointing out the particular item to be checked. Show the use of a simple check list copied from the content section of this module. . Explain the value of cleaning the tractor with a steam cleaner and have the students perform this task. It is assumed that instruction in the proper method of using the steam cleaner has already been given.	A. Observe demonstration given by the instructor of the steps in a visual inspection. Follow his checks as listed from the outline given you by the instructor. B. Set up the steam cleaner and clean up the tractor that is being tuned-up using the facilities available for this purpose.	D. Evaluate list prepared by each student. E. Instructor will observe the student performing the cleaning job and give credit on the basis of the cleanliness of the tractor when finished.
A. By use of a dynamometer, demonstrate the check of the tractors PTO horsepower. Refer to the supplement at the back of this module for further explanation and use of the dynamometer. B. Have the students list the steps under Procedure in the content of this module. Possibly handouts could be made by copying the supplement and given the students. C. Refer to manufacturer's manuals and compare results of the test. Analyze the data on the basis of this comparison and explain what adjustments are to be made or if the tractor should be given an overhaul.	A. Observe instructors demonstration listing the steps of procedure to be followed in performing a dynamometer check. B. Using this procedure and other references provided make a similar check with the dynamometer on tractor assigned.	F. Give credit for students' procedure in setting up, operating and removing the dynamometer. G. Check tractors' performance and compare results with each students' report.

Code - 01.0301-06

Title - TRACTOR ENGINE TUNE-UP

AGRICULTURAL

OBJECTIVES BY UNIT	CONTENT
Unit 4 - Tune-Up Procedures Objective 8 Fill out and complete work order on air and exhaust system of tractor.	A. Air Intake and Exhaust System . Clean out pre-cleaner . Remove and clean air cleaner . Swab out inlet pipe in air cleaner body . Inspect exhaust system and muffler . Crankcase ventilating system
Objective 9 Perform a vacuum test compression test, torque head bolts and adjust the valves to the manufacturers specifications.	B. Basic Engine - . Intake vacuum test (Diesel) . Manifold depression test (gas) . Cylinder head gasket leaks . Cylinder head bolt torque . Valve tappet clearence . Compression test

Objective 10
Check, adjust, and/or make necessary test of the ignition system.
	C. Ignition System
	. Spark plugs -
	  . clean, adjust gap & test
	  . replace if necessary
	. Distributor
	  . cap & rotor
	  . breaker points and condenser
	  . point clearence (can dwell)
	  . breaker spring tension
	  . lubricate cam and shaft
	  . test ignition coil
	  . adjust timing

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstrate the proper technique for servicing the various components of the air intake and exhaust systems. B. Show film strips "Air Cleaner and Crankcase Ventilating Service". C. Show students parts of an engine that has been ruined by a dirty air cleaner. D. Demonstrate the use of a vacuum gauge, compression gauge, torque wrench, valve tappet gap gauge and explain the proper sequence of head bolt torquing, also valve tappet adjustment. E. Demonstrate the correct procedure to follow in checking and adjusting the ignition system. F. Show film strip "Electrical System," first part which deals with the ignition components. G. Explain the "indicators" that will tell the student what could be happening within the engine which may be reason for using a different spark plug, or correcting polarity, etc.	A. Use the owner/operators manual with the tractor assigned and perform the necessary services to the air cleaner, exhaust system and the crankcase ventilator (tube, cap, etc.) B. Make a vacuum test, compression test and record findings. Compare with the manufacturer's specifications. C. Torque head bolts and valve tappet adjustments to the recommended specifications. D. Follow the procedure outlined by the instructor for checking the ignition components and make necessary adjustments, etc. to meet the manufacturer's specifications. E. Report any unusual "indicators" on tune-up report or work order so that information can be given to owner of tractor for future reference.	H. The completion of the check sheet and/or work order used for the tune-up will serve as a record of the students' performance and the resulting analysis of the tractor engine should indicate his level of proficiency. I. Accuracy of recorded data justifies completion of objectives. J. Accuracy of recorded data justifies completion of objectives.

OBJECTIVES BY UNIT	CONTENT
Unit 4 Tune-Up Procedures Objective 11 Check, adjust and/or correct problems of the fuel system.	D. Fuel System . Gasoline . clean sediment bowl . check liner for leaks and/or restrictions . fuel pump pressure . drain carburetor - clean inlet screen . adjust throttle control linkage . adjust carburetor and check engine speed . check choke disk operation . Diesel . clean fuel sediment bowl . check fuel lines for leaks and/or restrictions . check pump pressure . replace first state filter . remove, clean, and check injection nozzles . time injection pump . bleed fuel system . adjust governor control linkage and check engine speed . check stop knob operation

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
H. Show film strip "Fuel System and Fuel Storage" which points out the method and importance of clean fuel and proper storage of the fuel.	F. Perform the necessary checks to the fuel system whether gas or diesel and correct any deficiencies	K. Accuracy of recorded data justifies completion of objectives.
I. Show students parts of fuel systems that have been damaged by persons not acquainted with the proper method or procedure of adjustment.	G. Be observant of any of the indicators that might give reason to recommend better methods of refueling and/or fuel storage to the tractor owner/operator.	
J. Give a demonstration titled "Where Do Fuel Vapors Go?" showing the safety measures that should be observed during tune-up and maintenance of the engine.	H. Practice safety in the handling of fuel and especially spillage or leakage during the adjustment or cleaning of fuel system components.	

Code - 01.0301-06

Title - TRACTOR ENGINE TUNE-UP

OBJECTIVES BY UNIT	CONTENT
Objective 12 - Unit 4. Check, adjust, and/or correct problems in the lubrication system.	E. Lubrication System . Check pressure gauge or indicator light . Oil Filter . replace . Crankcase oil . check change interval . check quality recommendations . check for water or antifreeze contamination . Check pressure . master gauge
Objective 13 Check, adjust and/or correct problems of the cooling system.	F. Cooling System . Water pump . leakage . shaft end play . Radiator hoses . leakage or rot . Clean and flush the system . Thermostat . test for opening temperature . replace if necessary . Radiator . check cap pressure . check core for leaks . clean and straighten fins . Fan Belt . check of excessive wear, cracks, other signs of damage. . adjust tension

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
K. Review units on lubrication pertaining to oil selection, additives, and viscosity.	I. Perform the necessary services to the lubricating system of tractor engine assigned and report any deficiencies on check sheet or work order.	L. Accuracy of recorded data justifies completion of objectives.
L. Demonstrate the procedures for checking the oil for water or antifreeze contamination, Also the use of a master gauge to determine the accuracy of the engines pressure gauge.	J. Perform the recommended checks on services to the cooling system of the tractor assigned using references provided.	M. Accuracy of recorded data justifies completion of objectives.
M. Show film strip, "Lubrication" only the first half pertains to the engine lubrication and service procedures.	K. Make a notation on the check sheet or work order of the items that need to be given special attention by the owner/operator.	
N. Demonstrate how to check the thermostat for proper opening temperature, the proper method of removing the cap on a warmed up engine, and the procedure for checking and adjusting the fan belt.		
O. Show the students defective parts of the cooling system such as; thermostat, radiator cap, radiator core cut-a-way, and spongy hoses.		
P. Use film strip "Cooling Systems" for further explanation of the services necessary to the cooling system.		

Code - 01.0301-06

Title - TRACTOR ENGINE TUNE-UP

OBJECTIVES BY UNIT	CONTENT
Unit 4. Objective 14 Check, adjust and/or correct problems in the electrical system	G. Electrical System . Battery . clean cables, terminals, battery and box . tighten cable clamps . apply petroleum jelly or other sealer to posts and clamps . check electrolyte level . make "light-load" test . Generator or Alternator . . check belt tension . check gauge or indicator light operation . check out-put using tester and technical manual specifications . Regulator . check with batteries disconnected . Starting Circuit . check switches . check ampere draw . bearing lubrication

EDUCATION

01.0301-06 - Code

TRACTOR ENGINE TUNE-UP - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Q. Show the rest of the film strip "Electrical System" which demonstrates the procedure to follow in checking and servicing the battery, generator or alternator, regulator, and starting motor.	L. Be especially careful with the battery and its connecting cables when performing the necessary services.	N. Accuracy of recorded data justified completion of objectives.
R. Show students defective parts taken from electrical components and explain how these can be avoided.	M. Check all wiring and other connections when making the various tests necessary to the electrical system components.	
S. Demonstrate the proper use of the various instruments or test units to be used in checking the electrical system.	N. Record all data and compare it with the manufacturers specifications, make adjustments to meet these specifications.	

Code - 01.0301-06

Title - TRACTOR ENGINE TUNE-UP

OBJECTIVES BY UNIT	CONTENT
Unit 4.	
Objective 15 Check, adjust and/or correct malfunctions of clutch pedal controls.	H. Clutch Free Travel . Measure pedal free movement . check too much travel . check too little travel . check and use technical spec's.
Objective 16 Perform a final dynamometer test, to prove adjustments have restored the engine's efficiencies.	I. Dynamometer Test . Final Check . compare with first check . Determine - . engine HP . fuel consumption

EDUCATION

01.0301-06 - Code

TRACTOR ENGINE TUNE-UP - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
T. Show students worn out clutch assemblies caused by improper adjustment or lack of attention.	O. Refer to manufacturer's specifications and procedure for making the clutch pedal free travel adjustment.	O. Accuracy of recorded data justifies completion of objectives.
U. Demonstrate the proper clutch adjustment techniques on a cut-a-way assembly to more clearly present the necessity for proper adjustment.	P. Retest tractor on dynamometer and record all data for the analysis and comparison with pre-test.	P. Accuracy of recorded data justifies completion of objectives.
V. Explain the importance of the final dynamometer test and assist students in analyzing results and comparison with pre-test of engine.		

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE TUNE-UP   Code - 01.0301-06

RESOURCE MATERIALS

Books - Teacher References:

1. FOS Manual - Engines, Electrical, Power Trains, - John Deere Co. Moline, Ill.

2. Farm Tractor Maintenance and Tune-Up; International Harvester Co., Chicago, Ill.

3. Ford Tractor - Shop Manual; 1955-1960, Tractor and Implement Division, Ford Motor Co.

4. FT-53A Farm Tractors: Basic Principles, Operation and Maintenance; American Oil Co. --New York, New York.

5. Tune-Up Manual; Ignition Manufactureres Institute, Cleveland, Ohio.

Student References:

1. Modern Farm Power; Prentice-Hall inc. Englewood Cliffs, New Jersey.

2. Farm Tractor Maintenance: Principles and Procedures; AAEVA, Burrow Hall, Athens, Ga.

3. Gulf Farm Tractor Guide; Gulf Oil Corp., Houston, Texas

4. Farm Tractor Tune-Up and Service Guide, AAEVA, Burrow Hall, Athens, Ga.

5. Implement and Tractor Shop Manual; U&T Publications, Kansas City, Mo.

Periodicals -

1. Farm Power and Equipment; National Farm Power and Equipment Dealers' Assoc.
2. Implement and Tractor; Technical Publications Inc.
3. Successful Farming; DesMoines, Iowa
4. Heard's Dairymen's , Fort Atkinson, Wis.
5. American Agriculturalist; Ithaca, New York

Audio- Visuals -
1. Engine Slides; FOS; John Deere Co. Moline Ill.
2. Farm Tractor Maintenance; Film Strips, College of Agriculture, University of Nebraska, Lincoln, Nebraska.
3. ABC's of Internal Combustion, Brown Color, General Motors Corp. Detroit, Mich.

Tractor Engine Tune-Up

Many farmers' tractors fail to operate at peak efficiency because of a need for simple tune-up. Loss of power, increased fuel consumption, difficulty in starting, and overheating are all symptoms of this loss in efficiency and develop so gradually that the operator is scarcely aware of the need for a tune-up.

Why does the engine need a tune-up? After 250 hours of operation, the engine has taken a severe beating with considerable wear to its moving parts.

Distributor points have made 112 million contacts, every spark plug has fired 14 million high voltage sparks, the water pump has pumped 400,000 gallons of water, the fuel pump has pumped 700 gallons of gas and each valve has opened and closed 14 million times.

That is why your engine needs a complete engine tune-up after these hours of operation; to restore original performance, keep full economy at maximum and guard against engine failure in the field.

There are three requirements for successful operation of a tractor engine which should be considered in determining the need for tune-up and in correcting any difficulties found. They are: (1) compression, (2)ignition, and (3) carburetion. Trouble may occur in any or all of these areas and will seriously interfere with efficient operation.

To be effective, a tune-up should be performed by an experiencedmechanic with certain items of testing and tune-up equipment found in most equipment dealers' shops. They are: a compression gauge, a vacuum gauge, timing light, a flat feeler gauge, an ignition-point file, a set of ignition wrenches, a spark plug gap gauge (wire type), a set of spark plug wrenches or sockets. In addition to these items, a supply of standard mechanics' hand tools is necessary.

The operator's manual supplied with the tractor should be used as the chief source of specific tune-up information. This material is intended to supplement the operator's and also service manuals, and not a substitute for it.

DYNAMOMETER

A dynamometer, if used properly, can be a real aid both to the sales and service of our new tractors. However, if used improperly, a dynamometer can create problems which are actually non-existent. This article has been prepared to inform you of the factors to consider when using dynamometers.

BASIC USES OF A DYNAMOMETER

First, let us consider the basic uses of a dynamometer.

1. Measuring the horsepower output of an engine.

2. Placing a controlled load on the engine while making engine adjustments.

3. Applying a controlled load for breaking-in the engine.

NOTE: When measuring horsepower with a dynamometer, the horsepower readings can be read directly only at the specified speed (rpm). In any case where horsepower is to be determined, the speed of the shaft driving the dynamometer is not necessarily the speed of the engine.

FACTORS TO CONSIDER WHEN USING DYNAMOMETERS

1. CORRECT PTO SPEED. Use the correct PTO speeds when recording tractor horsepower.

   On previous model tractors the rated engine speed was also the maximum load speed and the horsepower rating was established at this speed and ONLY THIS SPEED. However, on new model tractors with the variable speed engines, the horsepower may be listed for several engine speeds. Because these horsepower ratings vary substantially with different engine speeds, it is imperative that the PTO speed driving the dynamometer be the same as the PTO speed listed for a particular horsepower in the following charts.

   For example, the advertised horsepower of the 4010 Gasoline Tractor is 80 horsepower at 2200 rpm engine speed.

   By referring to the first chart on the following page we see that when the PTO shaft is turning at 536 rpm the engine is turning at only 1900 rpm (not 2200 rpm) and is delivering 73 horsepower - not the advertised 80 horsepower.

   Again referring to the chart we see that in order for the engine to deliver 80 horsepower at 2200 rpm the PTO shaft must be turning at 620 rpm - not 536 rpm.

   This is why it is imperative that when using the dynamometer with the new model tractors the PTO shaft must be turning at the speed listed in the charts in order for the engine to be turning at the necessary rpm to deliver accurate horsepower reading.

Now that we have learned to use the correct PTO speed, it does not necessarily mean that we will get the exact horsepower ratings for the engine speeds listed in the charts. The following factors must be considered since they directly affect engine performance.

IMPORTANT: The tractor tachometer is designed as an operation guide for the tractor operator and is not sufficiently accurate for use with dynamometers. Use a good hand tachometer instead.

2. HORSEPOWER REQUIREMENTS OF ACCESSORIES. Many dynamometer operators fail to consider the horsepower requirements of hydraulic accessories. This problem is not as great with agricultural tractors as industrial tractors equipped with loaders, backhoes, direction reversers, etc.

For example, on the 1010 Crawler Loader with Hydraulic Direction Reverser, the Direction Reverser may require from two to five horsepower at 2500 rpm and the 24 gallon per minute loader pump may require one to four horsepower at 2500 rpm. There will also be a slight variation in the Hydraulic Direction Reverser power requirement if the unit is not level. Therefore, approximately nine horsepower could be consumed from the advertised 35 horsepower at 2500 rpm.

Therefore, do not be dissatisfied with engine performance because the horsepower reading is below that listed in the chart. Just remember that the engine is putting out the horsepower and that the difference is between your reading and the rated horsepower required to operate the hydraulic accessories.

Restrictions in the hydraulic lines, oil temperature, relief valve settings, and other possible hydraulic accessory combinations all affect the horsepower ratings and must be taken into consideration when using dynamometers.

3. WEATHER CONDITIONS. Most specifications such as the Nebraska Test figures and those listed in advertising literature are obtained under ideal conditions and, therefore, approach the maximum horsepower obtainable.

Actually operating conditions which can adversely affect the power output of an engine are altitude, air temperature, barometric pressure, and humidity. Horsepower will be decreased by three percent for each 1000 feet above sea level. Air temperature will decrease the output of an engine by about one percent for each 10 degrees above 60 degrees Fahrenheit. Low barometric pressure and low humidity can decrease horsepower by another six percent. Simple addition will show that in many areas it is not at all uncommon to lose 10 to 15 per cent of the engine output because of weather conditions.

These factors must be considered when comparing recorded data with horsepower ratings listed in advertising specifications and the Nebraska Tests.

4. ENGINE BREAK-IN. Many servicemen are trying to obtain the Nebraska Test Horsepower ratings on brand new tractors. It is very common for an engine to gain several horsepower during the break-in period. Even after 50 to 70 hours of operations, which is past the break-in period, 1010 and 2010 Series Tractor engines pick up one or two horsepower and 3010 and 4010 Series Tractor engines even more.

5. ENGINE WARM-UP. Engine warm-up does affect performance ratings. Dynamometer readings should never be taken until the engine has been run at least 15 minutes (or longer in cold weather) to be sure it is thoroughly warmed up.

6. ENGINE SET AT CORRECT FAST IDLE - NO LOAD SPEED. Because of the characteristic operation of the governor, it is essential that the engine be set at the correct fast idle speed before dynamometer tests are made.

   It is the governor that provides full fuel delivery under load. When a load is applied, the engine pulls down from the fast idle - no load speed and the governor linkage opens the carburetor butterfly valve or actuates the Diesel injection mechanism. This drop in rpm is sometimes referred to as "droop" or "lag", but is actually the difference between the fast idle - no load speed setting and the engine rpm at rated load speed. Therefore, the specified fast idle - no load speed must be set first as a start toward making sure the governor will provide full fuel delivery for maximum horsepower under load.

   NOTE: Worn governor weights, improperly adjusted linkage or binding linkage are factors which could prevent the governor from providing full fuel delivery.

   On tractors with gasoline engines you can double-check to make sure the governor is providing full fuel delivery by visually observing whether the carburetor butterfly is against its stop peg. If it is not the governor or governor linkage is not operating properly.

   Because the governor mechanism is usually enclosed on Diesel engines, just make sure the throttle lever is wide open.

7. VARIATION OR ERROR IN DYNAMOMETER. Portable field dynamometers commonly in use in service shops have been found to have up to a five per cent variation or error at their very best and when properly operated. Periodic calibration may show greater error than this in some cases.

CONCLUSION

A portable field type dynamometer is a convenient tool to apply a controlled load on a tractor for making adjustments, checking operating characteristics, break-in periods, and making comparison checks before and after service operations.

Study the instructions provided with your dynamometer to make certain you are operating it properly. On most dynamometers horsepower readings can be read directly on the dial only at 540 rpm or 1000 rpm. To obtain a horsepower reading for any other speed a calibration chart usually furnished with the dynamometer must be used.

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE TOP OVERHAUL Code - 01.0301-07

DESCRIPTION:

This module is designed to involve the student in step by step procedures used in completing an engine valve job. Students will demonstrate the importance of cleanliness required to successfully repair a mechanical assembly. Students will also utilize engine manufacturer specifications to properly diagnose required repairs, repair components to proper dimensions, make decisions of necessary parts replacement, and adjust components to specified tolerance. These students will perform post repair tests to final tune up an engine to obtain maximum efficiency.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocation	
	Class	Other
1. Diagnostic Test Procedures	1	4
2. Head Disassembly	2	2
3. Head Inspection	1	1
4. Valves, Guides and Seats	2	5
5. Valve Train	1	3
6. Reassembly Procedures	3	5
	10	20

Revised June, 1974

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE TOP OVERHAUL

Code - 01.0301-07

OBJECTIVES to be obtained:

Given a specific engine in need of valve train repair, the student or pair of students, will disassemble the valve system, properly using the tools and equipment available, following the manufacturers service procedures and in a time allotment satisfactory to the instructor.

Students will be able to:

1. Identify valve train malfunctions through diagnostic tests and procedures as outlined by the instructor.

2. Identify the major components of the valve train and explain the operational function of each.

3. Outline a work plan, following diagnostic tests, and identify procedures for tear down based on flat rate manual schedule.

4. Identify the cause of the malfunction by inspecting the condition of the components.

5. Identify the malfunctioning components and determine if they are repairable or require replacement.

6. Acquire and demonstrate skills for repair or replacement of components by performing the skills in a shop situation to the instructor's satisfaction.

7. Properly reassemble and adjust components to specifications from the shop manual.

01.0301-07

Title - TRACTOR ENGINE TOP OVERHAUL

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Diagnostic Test Procedure Objective #1 Identify valve train malfunctions through diagnostic tests and procedures as outlined by the instructor.	A. Obtaining information from owner B. Visual checks of condition of engine . Oil pressure and leaks . Coolant operating temperature and leaks . Inherent noises or knocks . Exhaust gas condition . Crankcase pressure - (Blow By) C. Lab Tests . Normal load . Compression test . Vacuum test . Dynamometer test . Observe condition and test spark plugs
Unit 2 - Head Disassembly Objective #2 Identify the major components of the valve train and explain the operational function of each.	A. Identifying components of valve train . Cam shaft and gear . Cam follower and tappet . Valves, springs, locks . Types of valve arrangements . L-Head . F-Head . I-Head
Objective #3 Outline a work plan, following diagnostic tests, and identify procedures for tear down based on flat rate manual schedule.	A. Steam clean engine B. Removing tin ware C. Removing Head assembly . Precautions of removal D. Cleaning procedure of components . Head . Valves (note excess deposits) . Rocker assembly

EDUCATION

01.0301-07 - Code

TRACTOR ENGINE TOP OVERHAUL - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture - Discussion . Information necessary to obtain . how and where to obtain . Importance of shop repair order . Visual conditions . Lab tests B. Demonstrate and Lecture . Lab tests C. Handout Sheets . Valve train components D. Use Shop Manual to . Show student where to locate specifications . Specifications and engine characteristics to diagnose problem	A. Obtain manufacturer's specifications for pre-repair tests. B. List conditions to observe to diagnose necessary repair C. Perform lab tests under (3a) in Content. D. Diagnose problem from . Visual observation . Lab tests . Record results	Written or oral test A. List components of valve train. B. List characteristics of specific conditions and determine possible cause. C. Assign specific engine for student to obtain specifications required to complete a valve repair job.
A. Lecture - Discussion . Components of the valve train . Important tear down procedure . sequence - wear pattern . flat rate schedule B. Handout Sheet -- showing . Three different valve arrangements . Typical valve train components	A. Disassemble engine valve train . Identify each component	Written or oral test A. List components of valve train B. Describe function of each C. Draw three various valve arrangements
A. Lecture - Discussion . Importance of predisassemble cleaning . Operation of steam cleaner . Tin ware removal procedure . Head removal procedure . Clean components	A. Steam clean a tractor engine B. Remove Head Assembly C. Determine from flat rate schedule . Jobs to be performed	Oral Discussion A. Disassembly and predisassembly procedures of performing a valve job. Written or oral test B. Given a specific engine . List flat rate jobs to be performed and hours allowed. Determine labor cost. . List causes of valve failure

01.0301-07

AGRICULTURAL

Title - TRACTOR ENGINE TOP OVERHAUL

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Head Inspection Objective #4 Identify the cause of the malfunction by inspecting the condition of the components.	A. Head Assembly . Warpage . Cracks . Deterioration B. Valves and Valve Guides . Burnt face or seat . Bent stem . Excess deposits . Excessive wear C. Causes of Failure . Excessive heat . Excess carbon . Preignition . Improper fuel . Improper lube oil . Improper air cleaner servicing . Excess heat
Unit 4 - Valves, Guides and Seats Objective #5 Identify the malfunctioning components and determine if they are repairable or require replacement.	A. Operations of valve seat refacer . Selection of proper stores B. Operation of valve face grinder C. Checking components against recommended tolerances . Width of valve seat . Width of face and runout . Method of reducing width . Valve stem diameter D. Valve inserts E. Valve guides F. Checking trueness of valve seat G. Rechecking seat contact with valve

E D U C A T I O N

01.0301-07 - Code

TRACTOR ENGINE TOP OVERHAUL - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture - discussing methods of . Checking components . Determining causes of failures or excessive wear . Use of shop manual to determine tolerance limitations B. Overhead transparencies showing various conditions of valve train component failures or irregularities. C. Display damaged components removed from engines. D. Group discussion using pamphlets showing pictures of valve failures.	A. Check shop manual listing specifications concerning and record . Warpage of head . Valve stem diameter . Valve guide wear . Bent valve stem . Rocker arm bushing wear B. Determine cause of excessive wear found in #1 above.	Oral Discussion A. Displaying previously removed failed valves and recite causes of failure for each B. Recite causes of . Head Failure C. Written or oral test Using shop manual - list pertinent specifications concerning valve inspection on a specific engine. D. Written or oral ability to identify each type of failure and its cause.
A. Lecture and Demonstration . Correct special tools to be used . Demonstrating where to locate specifications . Checking seat and face with dial indicator . Checking seat and face with prussian blue B. Handout sheet showing . Proper seat width . Proper face width . Reduced width of both	A. List valve, valve seat and face and guide specifications from shop manual. B. Complete a top-overhaul job including operating valve seat and valve face grinder.	Written or oral test A. List special tools required to perform a valve job. B. Describe procedure to reduce an excessively wide seat. C. List valve tolerances for a specific engine from the shop manual. D. Demonstrate skills to instructors satisfaction.

Title - TRACTOR ENGINE TOP OVERHAUL

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Valve Train Objective #6 Acquire and demonstrate skills for repair or replacement of components by performing the skills in a shop situation to the instructors satisfaction.	A. Checking Components . Cam followers . Valve springs . Valve lifters . Rocker arms bushings . Valve rotators . Rocker arm shaft . Push rods
Unit 6 - Reassembly Procedures Objective #7 Properly reassemble and adjust components to specifications from the shop manual.	A. Valves, springs etc. in head B. Cleaning of block assembly C. Installation of head gasket D. Install head on block assembly E. Torque head assembly . Tightening sequence F. Install push rods G. Install rocker shaft assembly to head . Torque per specifications H. Valve adjustment . Purpose of clearance . excessive clearance . insufficient clearance I. Adjusting procedure . Special tools

EDUCATION

01.0301-07 - Code

TRACTOR ENGINE TOP OVERHAUL - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture and demonstration discussing . Checking valve train components methods	A. Obtain specifications concerning valve train components from shop manual. B. Test valve springs for proper compression. C. Use Micrometers to Check . Rocker shaft diameter . Rocker arm bushing wear	Oral Discussion A. Procedure used to .Check valve springs .Push rods . Rocker bushings B. Demonstrate skills to instructors satisfaction.
A. Demonstration and Discussion . Reassembly of components . Adjusting procedure B. Slides or overhead transparencies showing . Torquing procedure of a head . Valve adjusting procedure	A. Obtain torque specifications for shop manual and record. B. Perform installation of components	Manipulative A. Illustrate head torquing procedure on a specific engine. B. Properly adjust the valve lash on a specific engine.

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE TOP OVERHAUL Code - 01.0301-07

RESOURCE MATERIALS

Books:

Fundamentals of Service - Engines, Moline, Ill. John Deere 1968

Jones, Fred R. Farm Gas Engines and Tractors McGraw-Hill, 1963, 518 pgs.

Tractor Repair Agricultural Machinery Service Occupations. Ohio State University Module 16 1965 - 59 pgs.

Implement and Tractor Service Manual, Kansas City, Mo. Implement and Tractor Publications, Inc. 1014 Wyandotte St.

Perfect Circle Service Manual. Hagerstown, Ind. Dana Corporation 1970

Manufacturers Service Manuals

Periodicals:

Implement and Tractor Magazine, Kansas City, Mo. Implement and Tractor Publications, Inc. 1014 Wyandotte St.

Audiovisuals:

Slides - Fundamentals of Service - Engines Moline, Illinois, John Deere, 1968

Filmstrips

Diagnose It First. Prescription for Longer Valve Life. Hagerstown, Ind. Dana Corporation

MODULE OF INSTRUCTION

Title - TRACTOR FUEL SYSTEMS (Non-Diesel)

Code - 01.0301-08

DESCRIPTION:

The student will adjust and repair gasoline fuel systems. He will become familiar with the common types of carburetors and the functions of the various parts, as they affect the efficient operation of the tractor engine. In addition to carburetors he will service and correct problems that may arise in air cleaners, fuel pumps, fuel filters, sediment bowls, and fuel lines. The student will spend most of his time in shop performing actual service and repair operations. Modern equipment will be used.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Other
1. Troubleshooting the fuel system	2	3
2. Principles of carburetion	1	1
3. Carburetor components	1	2
4. Servicing governors	2	4
5. Replacing fuel system parts	2	6
6. Tuning carburetors	2	4
	10	20

Revised June, 1974

MODULE OF INSTRUCTION

Title - TRACTOR FUEL SYSTEMS (Non-Diesel) Code - 01.0301-08

OBJECTIVES to be obtained:

The student will be able to:

1. Identify by name, eight components of a fuel system and describe the function of each.

2. Identify by name, and describe the functions of ten carburetor parts.

3. Disassemble, inspect, clean, repair and reassemble a carburetor in service shop conditions with special tools available. This is to be done within two hours and according to manufacturer's specifications.

4. Disassemble a centrifugal governor, identify major parts, reassemble and adjust for proper operation using regular shop equipment within flat rate time schedule.

5. Identify by name three types of air cleaners and perform necessary service on each type to manufacturer's specifications.

6. Check and clean or repair air and fuel filters according to manufacturer's specifications and time schedule.

7. Adjust carburetor on tractor engine for maximum efficiency, high idle, low idle and rated load speeds using electrical tachometer and/or P.T.O. dynamometer within flat rate time schedule and service manual specifications.

8. Troubleshoot and repair malfunctioning fuel system on a tractor engine using service manuals, special tools and gauges within flat rate time allocation.

AGRICULTURAL

Module TRACTOR FUEL SYSTEMS (Non-Diesel) 01.0301-08

OBJECTIVES BY UNIT	CONTENT
UNIT 1. Troubleshooting the Fuel System Objective 1 - Identify by name, eight components of a fuel system and describe the function of each	A. Fuel tank B. Fuel lines C. Fuel filter D. Fuel pump E. Aircleaner F. Carburetor G. Governor H. Manifold
UNIT 2. Principles of Carburetion Objective 2 - Identify by name, and describe the functions of ten carburetor parts	A. Theory of pressure differences. B. Venturi principle C. Fuel transfer . Gravity . Pressure

DUCATION

Module TRACTOR FUEL SYSTEMS (Non-Diesel) 01.0301-08

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Trace fuel and air through the fuel system on a tractor engine. Explain basic function of each component as fuel reaches that component. B. Relate each component to the entire system. Demonstrate removal of individual components from complete system for repair or replacement.	A. Remove fuel systems from tractor engines in preparation for repairs	A. Oral test of components and function
A. FOS Manual Engines 3-1 through 3-9 FOS Engine Slider 1647-1660 B. Impress need for clean fuel, filter, and lines (unclogged) and efficiency of fuel pump C. Demonstrate checking gravity flow and fuel pump pressure and vacuum. D. Instruct in using service manual speeds.	A. Check fuel system for dirt and/or slow flow. B. Use fuel pump pressure and vacuum gauge to check pump . C. Student refers to service manual for guidance	A. Oversee student in operation of this equipment - check his proficiency with oral questions.

AGRICULTURAL

Module TRACTOR FUEL SYSTEMS (Non-Diesel) 01.0301-08

OBJECTIVES BY UNIT	CONTENT
UNIT 3. - Carburetor Components Objective 3 - Dissassemble, inspect, clean, repair and reassemble a carburetor in service shop conditions with special tools available. This is to be done within two hours and according to manufacturer's specifications	A. Float B. Fuel bowl C. Venturi D. Throttle E. Mainjet F. Nozzle G. Air bleed H. Idle jet I. Choke J. Needle valve K. 3 types of carburetors: . Natural draft . Updraft . Down draft L. Carburetor systems . Fuel supply . Choke . Throttle . Load . Accelerating . Idle

DUCATION

Module TRACTOR FUEL SYSTEMS (Non-Diesel) 01.0301-08

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Disassemble a carburetor. Trace fuel flow thru each part and explain function of each part.	A. Clean the external surface of a carburetor and remove from line engine.	A. Written test on parts identification
B. Relate parts to systems of carburetor explaining operation of each.	B. Disassemble the carburetor, storing and checking each part in orderly fashion. Clean carburetor in carburetor cleaner fluid.	
C. Discuss fuel air mixture at various speeds and power output. Show 3 types of carburetors and explain.	C. Reassemble carburetor making initial adjustments as indicated by specifications in manual	
D. FOS Manual Engine 3-10 to 316. FOS Engine slide 1661-1676.	D. Check float adjustment - Install on engine and run engine	
Control initial carburetor disassembly in a step-by-step procedure assuring a clearer understanding by all students.		
F. Reassemble carburetor setting float level and making initial adjustments per service manual.		

Module TRACTOR FUEL SYSTEMS (Non-Diesel) 01.0301-08

OBJECTIVES BY UNIT	CONTENT
UNIT 4. - Servicing Governors Objective 4. Disassemble a centrifugal governor, identify major parts, reassemble and adjust for proper operation using regular shop equipment within flat rate time schedule	A. Principles of control and features of a governor. B. Centrifugal governor. C. Vacuum or automatic governor. D. Centrifugal governor operation control, and linkage adjustment.
UNIT 5. - Replacing Fuel System Parts Objective 5. Identify by name three types of air cleaners and perform repairs necessary on each type to manufacturer's specifications. Objective 6. Check and clean or repair air and fuel filters according to manufacturer's specifications and time schedule.	AIR CLEANERS A. Oil bath types B. Dry type C. Oil-soaked element type D. Pre-cleaner FUEL SYSTEMS A. Poor performance B. Poor idling C. Hard starting D. Poor acceleration E. Carburetor flooding F. Excessive fuel consumption

01.0301-08 - Code

TRACTOR FUEL SYSTEMS (Non-Diesel) - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Discuss the operation and drive of various governors. Disassemble a governor pointing out the major parts and their function. B. FOS Manual Engines 9-1 to 9-4. FOS Engine Slides 1958 to 1962. C. Demonstrate a faulty governor on a live tractor engine.	A. Remove and disassemble a governor from an engine. Inspect and repair governor if needed and replace on engine. Adjust governor to service manual specifications.	A. Written test on parts identification and function.
A. Show students an example of each type of air cleaner to discuss use of each. Prepare cutaways of the element to show construction and differences. B. Discuss and instruct on importance of proper maintenance of each type. C. Using a "Bugged" fuel system on an engine, demonstrate how a serviceman uses a dynamometer, electric tachometer, vacuum-pressure gauge to diagnose problems. D. Make necessary repairs and/or adjustments to correct problems. E. FOS Manual Engines 3-16 to 3-19.	A. Service the air cleaners of each type of engine. B. Students will be provided engines which have fuel system problems. They will check the system's operation using the necessary available gauges and tools (dyno., tach., gauges). Necessary repairs will be discussed with instructor and carried out by student. C. Final adjustments after repair bringing engine up to best operation efficiency using the above mentioned tools will be made.	A. Discussion between instructor and student concerning theory and operation.

Module TRACTOR FUEL SYSTEMS (Non-Diesel) 01.0301-08

OBJECTIVES BY UNIT	CONTENT
UNIT 6. - Tuning Carburetors	A. Engine testing by use of P.T.O. Dynamometer
Objective 7. Adjust carburetor on tractor engine for maximum efficiency, high idle, low idle and rated load speeds using electrical tachometer and/or P.T.O. dynamometer within flat rate time schedule and service manual specifications. Objective 8. Troubleshoot and repair malfunctioning fuel system on a tractor engine using service manuals, special tools and gauges within flat rate time allocation.	

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Laboratory exercise: Demonstration - Mechanical connection SAFE OPERATION Dynamometer theory on chalk board	A. Student watching demonstration and then doing exercise himself	A. Laboratory performance test on engine using dynamometer, vacuum-pressure gauge, and tachometer in diagnosing fuel system problems and in correcting them within the time indicated in manufacturer's shop rate schedules and to the manufacturer's specifications.

MODULE OF INSTRUCTION

Title - TRACTOR FUEL SYSTEMS (Non-Diesel) Code - 01.0301-08

RESOURCE MATERIALS

A. Books -

FOS (Fundamentals of Service)

Engines

John Deere Service Publication
John Deere Road
Moline, Illinois 61265

B. Bulletins -

Henderson, G.E. Tractor Operation and Daily Care
S.A.A.E.V.A. Athens, Georgia

Manufacturer's Service Manuals

C. Periodicals -

Implement and Tractor - Implement and Tractor Publications, Inc.
Kansas City, Missouri.

D. Audiovisuals -

FOS Engines Slides Kit

John Deere Service Publications
John Deere Road
Moline, Illinois 61265

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE IGNITION SYSTEM

Code - 01.0301-10

DESCRIPTION:

This module is designed to orient the student to the functions of the ignition system components. He will identify these components, explain their operational function, and perform diagnostic tests to determine if they are properly functioning. The student will perform proper maintenance procedures on the components when required. This will include magneto and battery ignition systems.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Identifying components.	2	3
2. Troubleshooting a Distributor	2	4
3. Selecting Spark Plugs	1	2
4. Servicing and Repairing a Magneto	2	4
5. Troubleshooting an Ignition Unit	2	8
	9	21

Revised June, 1974

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE IGNITION SYSTEM   Code - 01.0301-10

Objectives to be obtained:

Student will be able to:

1. Identify the components of a battery and magneto ignition system.
2. Explain the functional operation of each component.
3. Identify malfunctions of the distributor and efficiently test, adjust and repair assembly according to engine manufacturers per flat Rate schedule.
4. Identify various types, clean, adjust and test spark plugs.
5. Distinguish engine malfunctions from conditions of spark plugs.
6. Identify a magneto and explain its operation.
7. Troubleshoot, adjust and repair a magneto.
8. Complete a work plan to troubleshoot a complete ignition system on a vehicle.
9. Utilize available test equipment to repair a malfunctioning ignition system with available test equipment.

AGRICULTURAL

Module TRACTOR ENGINE IGNITION SYSTEM 01.0301-13

OBJECTIVES BY UNIT	CONTENT
Unit 1. Identifying components Objective #1 Identify the components of a battery and magneto ignition system.	A . Battery . Components of . Operation of . Types & ratings . Testing procedures B . Ammeter . Purpose . Types C . Ignition Switch . Purpose . Types . Test procedure D . Coil . Purpose . How it works . Test for Proper Polarity . Test coil to specifications
Objective #2 Explain the functional operation of each component.	E . Distributor . Purpose . Components . How it works . Adjustments and Time the engine F . Wiring harness and spark plug wires . Types of . Test procedure G . Spark Plugs . Types . Component parts of . Heat ranges H . Magnetos . Types . Principles of Operation . Components of . Adjustments and Test procedure . Provisions for timing engine

01.0301-10 - Code

TRACTOR ENGINE IGNITION SYSTEM - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture & Discussion on Purpose of system . Components of a typical ignition system . Chalkboard - Sketch a diagram of a typical ignition circuit. . Test procedures and special equipment for testing each component.	A. Identify components of ignition system.	A. Written Test . Sketch diagram of a typical electrical ignition system and label each component, define their purpose. . Identify the components and describe their functional purpose. . List ignition specifications for a specific engine. . Terminologies
B. Cutaway of Components	B. Trace an electrical ignition circuit on an engine and draw a schematic diagram of the system.	
C. Wall Charts	C. Perform tests to determine the condition of a battery and record results.	
D. Hand out sheet showing a typical electrical system and terminologies	D. Identify manufacturers specifications of each component by using the shop manual.	
E. Slides or Overhead Transparencies	E. Perform tests on ignition coils and wiring harness.	

OBJECTIVES BY UNIT	CONTENT
Unit 2 Troubleshooting a Distributor Objective #3 Identify malfunctions of the distributor and efficiently test, adjust and repair assembly according to engine manufacturers per flat Rate schedule.	A. Check condition of Battery B. Check ignition timing C. Set breaker points to specifications and check condition . Precautions - Cleaning points . Lubricate moving components . Check all wires and connections D. Re-test - Ignition Circuit . Oscilloscope method . Volt Meter and Dwell Meter E. Determine malfunction in distributor F. Remove distributor procedure G. Dismantle distributor . Inspect distributor cap and rotor for cracks, corrosion . Check point assembly for . grounds . pits, or burning . Check condensor . Check breaker point spring . Check advance mechanism per specifications . Check shaft bushings and drive gear H. Reassemble . Lubricating procedure during reassemble . Adjust points and install components I. Re-install on engine and reset system J. Discuss design variables of different manufacturers and different assembly models . Caps . center tower inserts . Rotors . Breaker Points . Condensors

EDUCATION

Module TRACTOR ENGINE IGNITION SYSTEM 01.0301-10

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture and Demonstration discussing . Tests and checks prior to removal of distributor from engine . Adjusting and servicing procedure . Retest Ignition System . Remove and dismantle distributor . Use and operation of test machines available B. Wall Charts C. Cutaway of a Distributor D. Overhead Transparencies or Slides E. Display of sample variables	A. List manufacturers specifications on specific distributor from Shop Manual B. Adjust timing of engine C. Check ignition system by both methods Using an Oscilloscope and/or Voltmeter.	A . Manipulative . Install set of points . Set ignition Timing static and per manufacturers specifications . Check operation with one of test equipment available B . Written or Oral Test . From "C" above determine course of a malfunction . List specifications from manufacturers Shop Manual required to Check "C" above . List 6 major components of a distributor

OBJECTIVES BY UNIT	**CONTENT**
Unit 3. Selecting Spark Plugs Objective #4 Identify various types, clean, adjust and test spark plugs.	A. Its purpose B. Construction of • Components • How it works • Variables . heat range . internal resistors C. Diagnosing engine characteristics from spark plug condition D. Cleaning procedure E. Testing procedure - • Operation of test equipment F. Reinstallation procedure
Objective #5 Distinguish engine malfunctions from conditions of spark plugs	G. Safety procedures servicing a plug

Module TRACTOR ENGINE IGNITION SYSTEM 01.0301-10

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A Lecture Discussing and Demonstrating . Purpose of a spark plug . Construction of spark plug . Variables of spark plug . Cleaning and adjusting procedures . Identify malfunctioning characteristics of an engine B Overhead Transparencies or Slides . Component parts of spark plug C. Sample plugs removed from an engine in service	A. Remove - clean - adjust - reinstall spark plugs in an engine. B. Obtain engine manufacturers specifications from Shop Manual and record C. Identify engine characteristics from observation of a spark plug condition D. Use cleaning and test equipment	Oral - A. Define Hot and Cold plug B. Describe conditions requiring a hotter and a colder plug C. Name precautions to take when servicing a set of plugs Manipulative - A. Clean, adjust and test a set of spark plugs and reinstall B. Following installation explain procedure followed.

OBJECTIVES BY UNIT	**CONTENT**
Unit 4. Servicing and Repairing a Magneto Objective #6 Identify a magneto and explain its operation.	A . Principles of Operation • Purpose of magneto • Compare with battery ignition B . Removal procedure C . Disassembly procedure • Define components • Purpose of each component D . Test components . Check condition of points, rotor and cap . Condenser test . Coil test . Switch test . Check condition of impulse . Hi tension wire
Objective #7 Troubleshoot, adjust and repair a magneto.	E . Reassemble . Clean and adjust . Lubricate F . Timing procedure

EDUCATION

Module TRACTOR ENGINE IGNITION SYSTEM 01.0301-10

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture and Discussion . Working principles . Removal procedure . Test procedures B. Demonstrate and Discussion . Disassemble . Test procedures C. Cutaway of Magneto D. Wall Charts	A. Disassemble magneto B. Test components with proper test equipment C. Adjust components D. Inspect cap-rotor, impulse for defects E. List manufacturers specifications for specific engine.	Written or Oral A. List components of a magneto B. Explain function of each C. Compare with battery ignition D. What to look for on impulse mechanism that causes failure Manipulative A. Adjust points B. Test condensor C. Test coil and wires D. Time the engine

OBJECTIVES BY UNIT	CONTENT
Unit 5. Troubleshooting an Ignition Unit Objective #8 Complete a work plan to troubleshoot a complete ignition system on a vehicle.	A. Pre-test Procedure • Obtain characteristic of engine from customer - record on Shop Work Order. • Record pertinent manufacturers specifications • Visual inspection of system - wires; components • Steam Clean if required • Dynomometer Test • Operation manuals for test equipment B. Install Oscilloscope to pinpoint problem C. Install appropriate test unit to further pinpoint malfunction. Repair or replace where necessary
Objective #9 Utilize available test equipment to repair a malfunctioning ignition system with available test equipment.	D. Re-check with oscilloscope re-check under load with dynamometer

01.0301-10 - Code

TRACTOR ENGINE IGNITION SYSTEM - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture and Discussion . Pre-test procedure . Identify polarity . Test equipment operation manuals . Firing order check	A. Obtain information concerning engine . From customer . Manufacturers specifications . Record results of dynamometer test	Manipulative Bug engine in each component area. A. List engine manufacturers specifications on ignition system.
B. Demonstrate use of test equipment by bugging an engine . Oscilloscope . Timing light . Coil test . Condensor test . Spark plug cleaner . Dwell meter . Adjust gap . Voltmeter - Amp meter . Ohm meter . Hydrometer	B. Pinpoint malfunctioning component by becoming familiar with oscilloscope. C. Become proficient using . Timing light . Coil - condenser test . Spark plug cleaner . Dwell meter . Volt - amp meter	B. Record characteristics noted on oscilloscope C. Outline verbally and perform subsequent tests necessary D. Describe test equipment to use to overcome problem E. Repair malfunction F. Re-test with oscilloscope

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE IGNITION SYSTEM Code - 01.0301-10

RESOURCE MATERIALS

A. Books - "Fundamentals of Service - Electrical Systems"
Publisher - John Deere Co., Moline, Illinois

"Tractors and Crawlers"
Author - Philip Eshelman (Second Edition)
Publisher - American Technical Society, Chicago, Illinois

B. Bulletins - Q. & T. Service Manuals

C. Periodicals - "Tune-up Tips" from Champion Spark Plug Company

D. Audiovisuals - "20,000 Volts Under the Hood"

Filmstrip with record and guide book from. Delco Remy.

MODULE OF INSTRUCTION

Title - **TRACTOR ENGINE FUEL SYSTEM** (Diesel) Code - 01.0301-09

DESCRIPTION:

The purpose of this module is to familiarize the student with the diesel fuel system used on Agricultural tractors and power units. This will include four types of basic combustion chambers, and various combinations of fuel injection pumps and injectors. The student will have an opportunity to identify the components of these pumps and injector nozzles. In addition he will have the opportunity to disassemble, clean and reassemble both pumps and nozzles. Following reassembly, the assemblies will be installed on test stands for final proper adjustment per manufacturers specifications.

Another phase of this module involves the actual troubleshooting of a diesel fuel system on a live unit. This will involve testing the unit on a dynamometer, diagnosing the problem, correcting the malfunction per manufacturers specifications and retesting the performance of the unit on the dynamometer.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Principles of Diesel Engine	1	1
2. Components of Diesel Fuel System	2	1
3. Diesel Combustion Chambers	2	1
4. Diesel Fuels	1	1
5. Injector Nozzle	3	6
6. Injection Pumps	3	8
	12	18

Revised June, 1974

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE FUEL SYSTEM (Diesel) Code - 01.0301-09

OBJECTIVES to be obtained:

The student will be able to:

1. Compare the diesel engine to the gasoline engine and state the principles of operation.
2. Identify the components of a diesel fuel system and state the operational function of each component.
3. Identify the different types of combustion chambers, and fuel systems.
4. Compare fuel specifications and identify a good grade of fuel from supplier's specifications.
5. Explain and recommend good fuel storage procedures.
6. Identify and properly use special tools required to service and test injection nozzles.
7. Identify and properly use special tools required to service and adjust injection pumps and transfer pumps.

Code - 01.0301-09

AGRICULTURAL

Title -
TRACTOR ENGINE FUEL SYSTEM (Diesel)

OBJECTIVES BY UNIT	CONTENT
Unit #1 - Principles of Diesel Engines Objective #1 - Compare the Diesel engine to the gasoline engine and explain the principles of operation.	A. Reasons for increased use of Diesel engines B. Comparison . 2 & 4 cycle sequence . Mechanical components . Fuel introduction . Combustion . Compression ratios
Unit #2 - Components of Diesel Fuel Systems Objective #2 - Identify the components of the Diesel fuel system and explain their operational function.	A. Components of Diesel system . Fuel Tank . construction . components . Transfer pumps . Filters . Injection pump . Injector nozzles . Fuel lines . Cold weather starting aids

01.0301-09 - Code

TRACTOR ENGINE FUEL SYSTEM (Diesel) - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture on principles B. Slides comparing Diesel vs. Gas (FOS slides #1771) C. Overhead comparing Diesel vs. Gas D. Hand Out Sheet		Oral or Written A. Quiz explain difference between gas and Diesel engines
A. Lecture using . Overhead of FOS illustrations . Slides showing various types of components B. Use actual components or cutaways C. Actual engine (Ford Display unit) . Identify components of a system D. Hand Out Sheet - Diagram of Typical System E. Demonstrate testing cold weather starting aide	A. Identify components on live units in the shop. B. Draw a schematic diagram of a live unit in the shop.	Quiz. A. Draw a schematic of a typical Diesel fuel system. B. Identify each component C. Explain operational function of each component.

Code - 01.0301-09

Title - TRACTOR ENGINE FUEL SYSTEM (Diesel)

OBJECTIVES BY UNIT	CONTENT
Unit #3 - Diesel Combustion Chambers Objective #3 - Identify types of combustion chambers and fuel systems.	A. Types of combustion chambers . Direct . Precombustion . Turbulence . Energy cell . Advantages and disadvantages B. Types of fuel systems . Common rail . Accumulator . Jerk pump . Distributor pump C. System requirements . Meter . Atomize . Distribute . Quantity . Timing D. Types of injector nozzles . Pintle . Pentaux . Closes . Multi hole
Unit #4 - Diesel Fuels Objective #4 - Compare fuel specifications and identify a good grade fuel from supplier specifications.	A. Fuel properties . Cetane number . Volatility . Pour point . Viscosity . Carbon and gum content . Sulphur . Cleanliness . Ease of starting . Lubrication ability

EDUCATION

01.0301-09 - Code

TRACTOR ENGINE FUEL SYSTEM (Diesel) - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture - explaining different types and their principles B. Hand out sheet illustrating each type C. Overhead showing all four types. D. Cutaway of engine head assembly. E. Actual components for each combustion chamber type - Head assembly Piston assembly F. Demonstrate disassembly of Auxilary Combustion Chambers. G. Utilize chalkboard showing types and differences. H. Compare system requirements with gasoline engine. I. Wall charts of four types of systems - . Identify components . Identify components satisfying requirements. J. Wall charts showing types of nozzles.	A. Draw diagrams of each type B. Explain advantages and disadvantages of each type. C. Identify type of combustion chamber on live engines. D. Identify type chamber by head and piston assembly. E. Identify components that satisfy the requirements.	Quiz A. Draw diagram identify each type B. Using actual components . Identify type C. Explain advantages and disadvantages. D. Identify components from Wall Charts. E. Define different type of nozzles and characteristics
A. Lecture on fuels & Lubricants B. Using manufacturers specs compare properties. C. Hand out sheets showing typical specifications. D. Supplier specification sheets	A. Compare fuel specs of various suppliers B. Compare sample fuels in test tubes	Quiz - Oral and Written A. Select best fuel from specification of 5 different fuel suppliers. B. List 5 important qualities of fuel to determine best fuel from supplier specifications.

Code - 01.0301-09

AGRICULTURAL

Title - **TRACTOR ENGINE FUEL SYSTEM (Diesel)**

OBJECTIVES BY UNIT	CONTENT
Objective #5 - Explain and recommend good fuel storage procedures.	A. Fuel storage . Tank components . Above ground . Under ground B. Do's and Don'ts of handling fuel
Unit #5 - Injector Nozzle Objectiva #6. - Identify and properly use special tools required to service and test injector nozzles and filter.	A. Diagnose engine specifications for Dynamometer test . No load speed . Loaded speed . Horse power output rating . Fuel flow/hour B. Compression Tester . Adaptors . Testing procedure C. Nozzle Test - Removal & Test Procedure . Pop off . Spray pattern . Leakage test . Back leakage . Precautions when testing D. Cleaning nozzle . Precautionary procedure . Introduce cleaning equipment . Disassemble procedure . Cleaning procedure . Reassemble and adjusting procedure . Retest procedure E. Reinstall Nozzles . Torque procedure F. Install new filters . Manufacturers recommendations G. Bleed fuel system

EDUCATION

01.0301-09 - Code

TRACTOR ENGINE FUEL SYSTEM (Diesel) - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture on Fuels and lubricants. B. Hand out sheets showing types of . Tanks . Components C. Slides and/or overhead showing storage . Tanks . Do's & dont's - handling fuel	A. Design outside storage tank . Under ground . Above ground B. Build a fuel storage tank	Quiz - Oral or Written A. Draw a typical storage tank and name its components. B. Define the function of each component. C. List or define 10 do's and dont's in good fuel handling procedures.
A. Hand out sheets showing engine specifications B. I & T Red Book Specifications C. Dynamometer Instruction Book for Specifications. D. Review manufacturers specifications for compression. E. Demonstrate actual compression test on live engine. F. Manufacturers Specifications for Nozzle . Hand out sheet . I & T specification sheet in Red Book. G. Demonstrate actual nozzle test H. Demonstrate cleaning procedure. I. Demonstrate installation procedure . Nozzles . New filter . Bleed system	A. Record engine specification for specific engine for dynamometer test. B. Run dynamometer test on an engine. C. Take compression test on live engine. D. Test sample nozzle per manufacturers specifications. E. Clean and retest nozzle per manufacturers specifications. F. Reinstall - torque injector in live engine. G. Install fuel filters H. Bleed system.	A. Select an engine to test on a dynamometer. B. Record required specifications. C. Perform dynamometer test. D. Perform compression test on live engine - . Record specification. . Record actual compression. . Recommendations from test results E. Perform cleaning and test procedure of a nozzle. F. Define procedure necessary to test injector nozzle. Oral or Written G. Explain nozzle reinstallation procedures. H. Explain filter installation procedure.

8

Code - 01.0301-09

Title - TRACTOR ENGINE FUEL SYSTEM (Diesel)

A G R I C U L T U R A L

OBJECTIVES BY UNIT	CONTENT
Unit 6 Injection Pumps Objective #7 - Identify and properly use special tools required to service, calibrate and adjust fuel injection pumps.	Principle of A. Unit injector B. Inline type pump C. Distributor type pump D. Transfer pumps

EDUCATION

01.0301-09 - Code

TRACTOR ENGINE FUEL SYSTEM (Diesel)- Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Follow test procedures, use specifications, and adjust per manufacturer recommendations. Using pump calibrator. B. Dismantle transfer and distributor type pumps. C. Use wall chart - to identify components. D. Demonstrate pump timing. E. Lecture concerning cleanliness.	A. Install pump on calibrating stand. B. Dismantle transfer and distributor type pump. C. Identify components of pumps from wall chart. D. Reinstall calibrated pump onto engine - proper timing. E. Bleed system.	Oral or Written A. Identify components of distributor-type pump. B. Explain pump timing procedure. C. Explain system bleeding procedure. D. Draw a schematic diagram of an actual system, identify the components, explain the operational function of each component.

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE FUEL SYSTEM (Diesel) Code - 01.0301-09

RESOURCE MATERIALS

A. Books - Kates, Edgar J. Diesel and High Compression Gas Engine,
Chicago: American Technical Society 1964.

Fundamentals of Service. Engineer Manual.

John Deere Service Publication
John Deere Road
Moline, Illinois 61265

B. Bulletins -

American Bosch Fuel Injection Equipment, Maintenance Information
American Bosch Acma Corp., Springfield, Massachusetts.
Fuel Systems, Diesel Engines Service Manual, International Harvester Co.
Chicago, Illinois

C. Periodicals -

"Diesel Equipment Superintendent" - Diesel Publication Inc.
80 Lincoln Avenue
Stanford, Conn.

D. Audiovisuals -

Fundamentals of Service Engineer Slides
John Deere Service Publication
John Deere Road
Moline, Illinois 61265

Wall Chart - PSB Single plunger Multi-cylinder
Fuel Injection pumps system

American Bosch Acma Corp., Springfield, Massachusetts

Wall Chart - CAV distributor - Mechanical & Hydraulic Governor

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE OVERHAUL - DISASSEMBLY   Code - 01.0301-11

DESCRIPTION:

This module will involve the student with removal of the engine from the tractor, tearing down the engine, and inspecting all parts for wear or damage. Included will be removal of the flywheel, clutch, pistons, cylinder sleeves, and camshaft. The student will learn to determine repairs needed and will prepare a list of needed parts.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Engine testing prior to overhaul		3
2. Remove engine from tractor and mount on repair stand (remove pan and oil pump)		3
3. Remove and inspect flywheel and clutch	1	2
4. Piston removal	1	3
5. Inspect and service piston pins and connecting rods		3
6. Determine cylinder condition	1	2
7. Remove and measure crankshaft	1	3
8. Sleeve removal	1	2
9. Camshaft removal and service	1	2
10. Clean engine block, check for cracks and distortion		1
	6	24

Revised August 1975

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE OVERHAUL - DISASSEMBLY Code - 01.0301-11

OBJECTIVES to be obtained:

Given a specific engine in need of repair, the student or pair of students, will perform pre-overhaul tests and disassemble the engine, properly using the tools and equipment available, following the manufacturer's service procedures, and in a time allotment satisfactory to the instructor.

By following service manual procedures, each student will be able to:

1. Perform the tests necessary to diagnose engine condition prior to overhaul
2. Safely and efficiently remove and mount the engine on an engine stand
3. After taking the clutch apart, will determine the amount of rebuilding necessary
4. Decide if the flywheel needs a new ring gear (remove and install)
5. After properly ridge reaming the cylinder, remove the piston assembly
6. Check piston wear and decide on using or replacing
7. Determine if connecting rods are bent, twisted, or out-of-round
8. Check piston pins and upper rod bushings for replacement
9. Measure the taper, diameter, out-of-round, and wall condition of the cylinders
10. Before crankshaft removal, check end-play, backlash, timing marks, and mark bearing caps
11. Determine taper, out-of-round, and wear of the crankshaft by measuring each journal
12. Demonstrate the ability to pull sleeves
13. Pull the camshaft, take measurements, and make the proper decision
14. Clean the block and check for cracks

Code - 01.0301-11

Title - TRACTOR ENGINE OVERHAUL - DISASSEMBLY

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Engine testing prior to overhaul Objective 1 Perform the tests necessary to diagnose engine condition prior to overhaul	A. Determining possible engine problems prior to overhaul . Talk to owner-operator . Observe exhaust . Listen to engine . Note oil pressure . Blow-by through crankcase breather . Water temperature . Engine testing B. Test analysis . Intake manifold vacuum . Dwell angle . High-low idle rpm . Compression test . wet . dry . Dynamometer test C. Recording and interpreting test results
Unit 2 - Remove engine from tractor and mount on repair stand (remove pan and oil pump) Objective 2 Safely and efficiently remove and mount the engine on an engine stand	A. Cleaning tractor B. Removing accessories and draining systems C. Remove engine block from tractor mounting . Draining oil . Removing front axle assembly D. Mounting engine on stand E. Remove oil pan and oil pump

E D U C A T I O N

01.0301-11 - Code

TRACTOR ENGINE OVERHAUL - DISASSEMBLY - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion with handout on procedure to follow	A. Record observations B. Participate in class discussion	A. Instructor observe records
B. Demonstrate performing each test C. Provide handouts of equipment use and procedure, i.e., . Vacuum gauge reactions . Compression testing . Dynamometer operation	C. Perform each test on engine assigned	B. Instructor observe student's procedure for safe, efficient, and proper technique C. Did student actually get accurate readings?
D. Hand out record sheet or utilize shop job sheet E. Class discussion of meaning of various readings accompanied by handouts and transparencies	D. Maintain record of test results on appropriate form E. Actually interpret each test result on his engine	D. Check record of test readings E. Check accuracy of diagrams F. Written or oral quiz
A. Demonstrate safe use of steam cleaner and proper cleaning of tractor B. Discuss following the service manual, since procedure varies with make and model C. Demonstrate proper hoisting, chaining, and blocking using safety practices D. Demonstrate proper mounting of engine Module #16, Tractor Repair, page 12	A. Thoroughly clean tractor or engine assigned B. Safely and efficiently remove and mount the engine on a stand C. Properly remove pan and oil pump	A. Teacher observation if procedure is correct and performed safely

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Remove and inspect flywheel and clutch Objective 3 After taking the clutch apart, will determine the amount of rebuilding necessary	A. Clutch service and repair . Inspect parts . Measure tolerances
Objective 4 Decide if flywheel needs a new ring gear (remove and install)	B. Flywheel service . Ring gear
Unit 4 - Piston removal Objective 5 After properly ridge reaming the cylinder, remove the piston assembly	A. Cylinder ridge removal B. Clamping sleeves C. Rod cap identification D. Removal of rod cap E. Removal of piston from cylinder
Unit 5 - Inspect and service piston pins and connecting rods Objective 6 Check piston wear and decide on using or replacing	A. Removing piston rings B. Cleaning piston and ring grooves C. Inspect and measure piston . Cracks . Ring lands . Skirt wear pattern . Piston clearance

E D U C A T I O N

01.0301-11 - Code

TRACTOR ENGINE OVERHAUL - DISASSEMBLY - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstrate removing clutch, inspecting parts, and measuring tolerances B. Class discussion of clutch troubles and causes FOS Power Trains, chapter 2, and slide set	A. Disassemble clutch B. Perform measurement and inspection C. Determine if rebuilding and parts are needed	A. Teacher agreement with repair analysis B. Observe if job was done properly
C. Discussion of flywheel Checks including ring gear FOS Engines, chapter 2 D. Demonstrate removing and replacing ring gear Module #16, page 13	D. Remove and install new ring gear, if necessary	
A. Demonstrate use of ridge reamer and discuss purpose of removing B. Filmstrip C. Field trip to engine rebuilder D. Discussion of procedure and importance of identifying rod caps and removing pistons E. Use FOS Engines, chapters 2 - 25 F. Module #16, page 14	A. Student will ridge ream and remove pistons from the tractor he is working on	A. Observe student doing work and finished job
A. FOS Engines, chapter 2 - 3 to 42 B. Demonstrate cleaning with ring groove cleaner and measuring D. Class discussion using FOS slides	A. Student will clean, inspect, and measure pistons to decide if replacement is necessary	A. Observe student's work and check decisions

OBJECTIVES BY UNIT	CONTENT
Objective 7 Determine if connecting rods are bent, twisted, or out-of-round	D. Check rods for bend, twist, out-of-round
Objective 8 Check piston pins and upper rod bushings for replacement	A. Measuring pins and bushings B. Pressing out old rod bushings C. Types of piston pin arrangements
Unit 6 - Determine cylinder condition	
Objective 9 Measure the taper, diameter, out-of-round, and wall condition of the cylinders	A. Determining taper, diameter, out-of-round with cylinder gauge B. Deglazing or honing cylinders C. Cleaning cylinders
Unit 7 - Remove and measure crankshaft	
Objective 10 Before crankshaft removal, check end-play, backlash, timing marks, and mark bearing caps	A. Check end-play B. Removing crankshaft pulley C. Removing timing cover D. Check backlash between cam and crankshaft gears E. Timing marks F. Bearing cap identification
Objective 11 Determine taper, out-of-round, and wear of the crankshaft by measuring each journal	A. Check each journal (main and rod) . Out-of-round . Taper . Diameter . Wear B. Crank grinding, inspection, straightening

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
C. Demonstrate checks D. Class discussion using FOS Engines, chapter 2-45,46 as reference E. Module #16, pages 14-15		
A. Demonstration B. FOS Engines, chapter 2-44,45 C. Module #16, page 15	A. Student will determine by measurement whether pins and bushings need replacing. If so, push out old bushing.	A. Check the decision
A. Discussion and demonstration FOS Engines, chapter 2 - 25 to 29 FOS Engine slides	A. Student will measure taper, diameter, out-of-round. He will deglaze if usable or pull if a new sleeve is needed.	A. Check measurements and job done
A. Demonstrate checking end play, backlash, pulling pulley B. Discussion of timing marks, bearing cap identification. FOS Engines, chapter 2 - 48 to 54 and slides	A. Measure end-play, backlash, check timing marks, identify caps before pulling crank B. After removing the crankshaft students will determine, visually and by measuring, if the crankshaft needs regrinding	A. Check measurements and decision
A. Demonstrate a-c B. Discussion of grinding, inspection and straightening C. Module #16, pages 16-17		

Code - 01.0301-11

Title - TRACTOR ENGINE OVERHAUL - DISASSEMBLY

OBJECTIVES BY UNIT	CONTENT
Unit 8 - Sleeve removal Objective 12 Demonstrate the ability to pull sleeves	A. Use of sleeve puller for wet and dry sleeves. Proper size puller plates
Unit 9 - Camshaft removal and service Objective 13 Pull the camshaft, take measurements, and make the proper decision	A. Measure bearing journals, lobes, cam bores, or bearings B. Remove cam bushings C. Cam timing, cam followers
Unit 10 - Clean engine block, check for cracks and distortion Objective 14 Clean the block and check for cracks	A. Cleaning block with available equipment B. Check for cracks C. Distortion

01.0301-11 - Code

TRACTOR ENGINE OVERHAUL - DISASSEMBLY - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstration	A. If student has decided sleeves are faulty, remove them using proper puller	A. Observe students. If not to be done on his engine, have him demonstrate how he would do it, minus actual pulling
A. Demonstration and discussion B. FOS Engines, chapter 2 - 17 to 20 C. FOS Slides D. Module #16, page 18	A. Remove camshaft B. Take measurements C. Remove bushings	A. Check measurements and resulting decision
A. Demonstrate procedure B. Discuss other methods C. FOS Engines, chapter 2 - 23 to 26	A. Clean block and check for cracks and distortion with equipment available	A. Check cleanliness, safety, and accuracy

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE OVERHAUL - DISASSEMBLY   Code - 01.0301-11

RESOURCE MATERIALS

Books -

Teacher References

1. Service Manual for Doctor of Motors. Dana Parts Co., Box 500, Hagerstown, Ind. 47306
2. I & T Shop Service. Technical Publications, Inc., 1014 Wyandotte St., Kansas City, Mo. 64105
3. Fundamentals of Service Engines. John Deere. Moline, Ill.
4. Fundamentals of Service Power Trains. John Deere
5. Module 16 - Tractor Repair. Eric Document Reproduction Service. 4936 Fairmont Ave., Bethesda, Md. 20014
6. Engine Bearing Service Manual. Federal Mogul Service, Detroit, Mich. 48213
7. Farm Tractors. Engineering Bulletin 53A. American Oil Co., 910 S. Michigan Ave., Chicago, Ill.

Student References

1. Fundamentals of Service Engines. John Deere, Moline, Ill.
2. I & T Manual for tractor involved

Periodicals -

Teacher References

1. Implement and Tractor. Implement and Tractor Publications, Inc. 104 Wyandotte St., Kansas City, Mo. 64105
2. Magic Circle. Dana Corporation. P.O. Box 986, Toledo, Ohio 43601

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE OVERHAUL - DISASSEMBLY Code - 01.0301-11

RESOURCE MATERIALS

Audiovisuals -

Films -

1. Case of the Slippery Oil. 40 min. 16 mm. sd color
2. Dirt - Engine Enemy #1. 10 min. 16 mm. sd color
   Technical Service Department, Dana Parts Co., Box 500, Hagerstown, Indiana 47346

Filmstrips -

1. Diagnosing Excessive Oil Consumption and Engine Overhaul Procedure
2. Diagnose it First. 80 frame filmstrip. 40 min. color
3. Installing Piston Rings in Farm Tractors. 2 class periods. 35 mm. color
   Technical Service Department, Dana Parts Co., Box 500, Hagerstown, Indiana 47346
4. FOS Engines Slide Set
5. FOS Power Train Slide Set

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE OVERHAUL - REASSEMBLY   Code - 01.0301-12

DESCRIPTION:

In this module, the student will install needed new parts and reassemble the engine, with necessary adjustments, bushings and gaskets. He will overhaul and re-install the oil pump, replace the head and valve train. He will re-install the distributor, generator, starter, manifold and other engine parts. When the engine is properly reassembled the student will adjust it for optimum operating efficiency, using a dynamometer and electronic testing equipment. The tractor will then be field tested and rechecked to manufacturers specifications.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Install camshaft and bushings and cylinder sleeves	1	4
2. Install crankshaft, timing gear cover and pulley		4
3. Install pistons on connecting rod, insert in cylinder bore	1	4
4. Overhaul and install oil pump, install oil pan	2	3
5. Install flywheel and clutch		2
6. Install head, valve train, distributor, generator, starter, manifold and other engine parts	1	2
7. Tune-up, break-in		

Revised June, 1974

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE OVERHAUL - REASSEMBLY

Code - 01.0301-12

OBJECTIVES to be obtained:

Continuing with the same engine used in the disassembly (01.0301-11) module, the student or pair of students will reassemble the engine, using properly the tools and equipment available, following the manufacturers procedures and in a time period satisfactory to the instructor.

The student will be able to:

1. Using a camshaft bushing driver, install the camshaft bushings; put in the camshaft according to specifications.
2. Install cylinder sleeves, following the recommendations.
3. Properly install the crankshaft, oil seals, timing gear cover and pulley.
4. Correctly fit pin bushings, assemble rod and piston, install rings and install rod and piston assembly in the cylinder bore.
5. Disassemble the oil pump, check clearances with manufacturers specifications and install an oil pump overhaul kit if needed; prime oil pump and install.
6. Install the flywheel; install clutch assembly, using clutch aligning tool and adjust to specifications.
7. Using the information learned in the Top Overhaul module, install the head and valve train.
8. Using the information learned in the Ignition Systems module, install the distributor and wiring harness.
9. Test and overhaul the generator if necessary.
10. Test and overhaul the starter if necessary.
11. Reassemble the other engine parts and get the engine and tractor back together.
12. Start the tractor, following an outlined procedure after major overhaul.
13. Follow the manufacturers' recommended break-in procedures; tune-up engine to the manufacturers' specifications.

Code - 01.0301-12

Title - TRACTOR ENGINE OVERHAUL - REASSEMBLY

AGRICULTURAL

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Install camshaft and bushings and cylinder sleeves Objective #1 Using a camshaft bushing driver, install the camshaft bushings; put in the camshaft according to specifications.	A. Use of bushing driver; line up oil holes; check cam followers; install camshaft (damage to bushings); check end play with specifications.
Objective #2 Install cylinder sleeves, following the recommendations.	A. Installation of wet sleeves . Height above block, cleaning, seals B. Dry sleeve installation . Check cylinder bore; use of sleeve puller
Unit 2 - Install crankshaft, timing gear cover and pulley Objective #3 Properly install the crankshaft, oil seals, timing gear cover and pulley.	A. Installation of bearing inserts, oil seals, timing cover and pulley. B. Main bearing cap position and clearance with plastigage. C. Crankshaft end play; correct timing (references) . Related information . crank and engine balancers . bearings - crush, thrust, failures. (if not already done elsewhere) - references
Unit 3 - Install pistons on connecting rod, insert i cylinder bore. Objective #4 Correctly fit pin bushings, assemble rod and piston;install rings and install rod and piston assembly in the cylinder bore.	A. Put in new pin (upper rod) bushings and fit to pin. B. Proper assembly of rod and piston unit C. Checking new rings for size (end gap) D. Proper ring installation E. Installation in sleeve, rod cap placement and clearance (check with plastigage) (references) F. Related information - . Types and function of rings . Types of piston pins (references)

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstration B. Discussion C. References	A. Student will install camshaft bushings and replace camshaft; check specifications.	A. Observe the procedure, results and check end play.
A. Demonstration B. Discussion C. FOS slides D. Reference: . FOS Engines ch2-29 Module #16 p/19	A. Student will install the sleeves in his engine.	A. Check his work; check his procedural knowledge of the other type sleeve.
A. Demonstration B. FOS Slides C. Damaged bearing display D. Discussion E. References: . FOS Engines ch 2-53,54 Modules #16 p.20,21 . FOS Engines ch 2 54-60 Bul 53A p 71-75 Ball & Roller Bearings	A. Student will install crank, aligning thrust bearing/washers properly; check clearance with plastigage; check end play; get timing correct; oil seals, cover and pulley.	A. Observe plastigage and end play checks. B. Check oil seal installation, timing marks. C. Written test on related information.
A. Demonstration B. FOS Slides C. Film - Installing piston rings in farm tractors D. References: . FOS Engines ch 2 43-48 Module #16 p. 21-23 Bul FT 53A p 39, 40 . Rx For Better Gasoline Engine Overhauls . Service Manual for the Doctor of Motors	A. Student will fit piston pins; check ring end gap; install ring set; install in sleeve and check bearing clearance.	A. Observation: Piston ring installation test.

OBJECTIVES BY UNIT	CONTENT
Unit 4 - Overhaul and install oil pump, install oil pan Objective #5 Disassemble the oil pump, check clearances with manufacturers specifications and install an oil pump overhaul kit if needed; prime oil pump and install.	A. Pump disassembly, clearances, install overhaul kit. B. Possible pump housing replacement C. Pump priming importance, bolt torque, locks D. Oil pan installation E. Related information . Tractor lubrication systems . types - filters, pressure regulation (references)
Unit 5 - Install flywheel and clutch Objective #6 Install the flywheel; install clutch assembly, using clutch aligning tool and adjust to specifications.	A. Install flywheel, torque, measure run out B. Install clutch - pilot and release bearings, align clutch disc, clutch spring tension, adjust clutch fingers - (references)
Unit 6 - Install head, valve train, distributor, generator, starter, manifold and other engine parts. Objective #7 Using the information learned in the Top Overhaul module, install the head and valve train.	A. Review head and valve train installation procedures.
Objective #8 Using the information learned in the Ignition Systems module, install the distributor and wiring harness.	A. Review the distributor and ignition system hook-up.

01.0301-12 - Code

TRACTOR ENGINE OVERHAUL - REASSEMBLY - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstration B. Discussion C. FOS Slides D. References: . FOS Engines ch 7 2-4, all Module #16 p. 23	A. Measure pump tolerances and rebuild if necessary.	A. Check measurement and resultant decision on rebuilding. B. Written test on related information.
A. Demonstration B. FOS PT Slides C. References: . FOS Engine ch 2. p. 61 FOS Power Trains Ch. 2	A. Student will install flywheel and clutch assembly, checking specifications and manufacturers recommendations.	A. Observe during and check completed assembly.
A. Demonstration B. Discussion C. Refer to Top Overhaul Module	A. Install head and valve train.	A. Check results
A. Refer **back** to Ignition Systems module	A. Install distributor (correctly timed) and wire ignition system.	A. Observing timing and wiring

Code - 01.0301-12

Title - TRACTOR ENGINE OVERHAUL - REASSEMBLY

OBJECTIVES BY UNIT	CONTENT
Objective #9 Test and overhaul the generator if necessary.	A. Disassembly procedure and cleaning B. Armature check tests C. Field coil tests D. Commutator turning and mica undercutting E. Polarize (references)
Objective #10 Test and overhaul the starter if necessary.	A. Disassembly procedure and cleaning B. Drive mechanism C. Check field coils D. Check armature E. Check bushing wear (references)
Objective #11 Reassemble the other engine parts and get the engine and tractor back together.	A. Water pump overhaul (references) B. Cooling system cleaning, testing thermostat, radiator cap (references) C. Governor linkage and adjustment (references)
Unit 7 - Tune-up, break-in Objective #12 Start the tractor, following an outlined procedure after major overhaul	A. Review of Tune-up module if taught before this B. Adjust valve tappets, carburetor, engine timing as accurately as possible before starting. Service for water, fuel, oil, filters, lubrication. Start tractor - check oil pressure, rocker arm lubrication, oil and water leaks, noises, ammeter.
Objective #13 Follow the manufacturers recommended break-in procedures; tune-up engine to the manufacturers specifications.	A. Follow manufacturers recommended procedure for break-in. B. After break-in: . Retighten head . Recheck valve clearances . Engine timing . Carburetor settings C. Dynamometer test (references)

01.0301-12 - Code

TRACTOR ENGINE OVERHAUL - REASSEMBLY - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstration B. Reference: . Module #16 p. 29, 30 FOS Electrical Systems	A. Test generator output against manufacturers specifications; clean; replace brushes; polarize on installation.	A. Observe testing procedure
A. Demonstration B. Discussion C. FOS Slides D. Reference: . Module #16 p. 30, 31 FOS Electrical	A. Clean and check for wear; test output to manufacturers specifications.	A. Observe tests
A. Demonstration B. Discussion C. FOS Slides D. Reference: . Module #16 p. 29 . FOS Engines ch. 8 all . FOS Engines ch. 9 all	A. Student will clean, test & repair the cooling system; get the engine & tractor ready to run.	A. Watch for safety procedures & inspect completed job.
A. Refer to module B. Demonstration C. Discussion	A. Check & adjust valve lash, engine timing, carburetor adjustments; B. Be sure of oil filters, oil, lubrication, water, fuel before starting. C. Start engine	A. Be present at starting.
A. Demonstration B. Discussion C. References: . FOS Engines ch 2 p. 63	A. Break-in and tune engine according to manufacturers recommendations and specifications.	A. Visual observation and dynamometer test.

MODULE OF INSTRUCTION

Title - TRACTOR ENGINE OVERHAUL - REASSEMBLY Code - 01.0301-12

RESOURCE MATERIALS

A. Books -

Teacher References

Ball and Roller Bearings - International Harvester Co.
Farm Tractors. Engineering Bulletin FT 53A. American Oil Co. 910 So. Michigan Ave., Chicago, Ill.
Fundamentals of Service - Engines. John Deere Co.
Fundamentals of Service - Power Trains. John Deere Co.
Fundamentals of Service - Electrical Systems. John Deere Co.
I & T Shop Service. Technical Publications, Inc. 1010 Wyandotte St., Kansas City, Mo. 64105
Module #16 Tractor Repair. Eric Document Reproduction Service 4936 Fairmont Ave., Bethesda, Md 20014
Rx For Better Gasoline Engine Overhaul. Dana Parts Co., Box 500, Hagerstown, Ind. 47306
Service Manual For Doctor of Motors. Dana Parts Co., Box 500, Hagerstown, Ind. 47306

Student References

Fundamentals of Service - Engines. John Deere Co.
I and T Manual for particular tractor and/or manufacturers Service Manual

B. Periodicals -

Teacher References

Implement & Tractor. Implement and Tractor Publications, Inc. 1014 Wyandotte St., Kansas City, Mo. 64105

C. Filmstrips -

Installing Piston Rings in Farm Tractors. 2 class periods 35 mm color
Librarian, Technical Service Dept.
Dana Parts Co., Box 500, Hagerstown, Ind. 47306
FOS Electrical Systems Slide Set
FOS Engines Slide Set
FOS Power Trains Slide Set

MODULE OF INSTRUCTION

Title - AGRICULTURAL POWER TRAINS Code - 01.0301-13

DESCRIPTION:

The complexity of the construction of agricultural equipment makes it essential for the student to study power transmissions and mechanical driving systems. Both wheel and crawler tractors can be used to study components, systems and operation. Through demonstration and practice, students will learn the principles and mechanics of the operation of clutches, transmissions, torque and hydraulic drives, differentials, final drives and power-take-offs.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Principles of Powertrains	1	1
2. Clutches	1	4
3. Transmissions	1	6
4. Differentials	1	6
5. Final Drives	0	2
6. Brakes	0	4
7. Power Take-offs	1	2
	5	25

Revised June, 1974

MODULE OF INSTRUCTION

Title - AGRICULTURAL POWER TRAINS Code - 01.0301-13

Objectives to be obtained:
The student will be able to:

1. Explain how the power train works in the farm tractor.
2. Identify the different types of clutches used on the modern farm tractor.
3. Explain the methods of operating clutch assemblies in today's modern equipment.
4. Recognize the typical clutch troubles found in farm equipment.
5. Determine the extent of wear on disk facing and the need for replacement.
6. Identify types, parts or components, and disassemble for repair or replacement of parts when needed.
7. Diagnose and isolate malfunctions in the transmission which can be corrected through adjustment.
8. Describe the jobs performed by the differential and how they are accomplished.
9. Explain the type and operation of the differential locks found on today's farm tractors.
10. Identify the type of final drive assembly found on many items of farm equipment.
11. Determine the cause of failure from inspection of parts removed from a faulty assembly.
12. Remove, inspect and repair the brakes on a tractor found to have no brake action during field operation.
13. Solve the problem of a malfunctioning PTO of a tractor brought in for service.
14. Remove, disassemble and repair the universal joint on the drive shaft for a PTO operated machine.
15. List six safety precautions to be observed around PTO operated equipment.

Code - 01.0301-13

Title - AGRICULTURAL POWER TRAINS

OBJECTIVES BY UNIT	CONTENT
1.Principles of Power Trains Objective 1 Explain how the power train works in the farm tractor.	A.Basic Purpose .Connects and disconnects power .Selects speed ratios .Provides a means of reversing .Equalizes power to the drive wheels for turning B.Components .Clutch-to connect and disconnect power .Transmission-to select speeds and direction .Differential-to equalize power for turning C.Operation .Foot or hand operated lever engages discs of clutch .Transmission through gears changes speeds in relation to drive wheels. .Differential allows each wheel to travel a different speed and still propel its own load.
2.Clutches Objective 2 Identify the different types of clutches used on the modern farm tractor	A.Types .Disc-two or more plates are brought together to transmit torque .Plate--a single plate is clamped between two driving parts to transmit torque .Band--an outside band is tightened over a moving part to transmit torque .Overrunning--engagement is allowed in one direction, but the unit freewheels in the other. .Magnetic--a magnetic field holds two parts together allowing them to rotate as a unit .Cone--two cone-shaped parts are engaged to transmit torque .Expanding-shoe--an inner shoe is expanded to contact an outer part to transmit torque

EDUCATION

01.0301-13 - Code

AGRICULTURAL POWER TRAINS - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A.Review the various references listed on the resource page and select those available for ready use.Obtain the others necessary to complete library. B.Bring before the class an item of equipment which operates through pulley and belt from a stationary engine.Remove the pulleys and belts,start the engine,and ask students to explain why the item of equipment is not working. C.Obtain a tractor and some other piece of equipment with a mounted engine into the shop for student examination.Have the students list the points or places through which power is transmitted from the source to the use.	A.Study reference information assigned or provided about the power train. B.Learn the proper names,location, and functions of the clutch, transmission,differential,and final drive units. C.Observe the demonstrations given by the instructor and participate in the discussions about the power train, then do some of the following -- .Determine the speeds of various devices in the power train .Demonstrate proper connection and operations of the PTO. .Suggest safety rules to be observed around various parts of the power train.	Have students explain orally or in writing how the power train works.
A.Lay out on the benches in the shop area a clutch of each type identified in the content and demonstrate how each one works. B.Take students to the equipment storage area and observe the various applications of clutches on the machinery.	A.Survey the home farm and list the various types of clutches used on the machinery owned and operated. B.Other student activities .Check a tractor clutch assembly for wear and need for adjustment .Adjust a clutch pedal free travel .Determine amount of face wear of a clutch disk	Use car identification type sheet with numbered clutch types **laid** out on benches or illustration sheets made from parts manuals.

Code - 01.0301-13

Title - AGRICULTURAL POWER TRAINS

OBJECTIVES BY UNIT	CONTENT
Objective 3 Explain the methods of operating clutch assemblies in today's modern equipment	B. Operating Mechanisms .Mechanical .standard linkage--most common .over-center linkage--mechanical locking .Hydraulic .Electrical .direct-action .indirect-action C. Maintenance .plate .disc .flywheel .release bearing
Objective 4 Be able to recognize the typical clutch troubles found in farm equipment	D. Troubleshooting of clutches . Eight basic clutch troubles .clattering--especially in low or reverse speeds .dragging--or failure to release promptly and fully .squeaks--particularly when pedal is depressed .rattles--especially at low speeds or standing .grabbing--violent and sudden engagement .slipping--failure to transmit full power .vibrations at either high or low speed or periodically .failure to transmit power at all
Objective 5 Determine the extent of wear on disk facing and the need for replacement.	

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Have students disassemble each type of clutch discussed in the content, learn its parts and reassemble. B. Demonstrate the proper use of special tools for servicing and/or adjusting clutches.	Observe demonstration of proper use of special tools and learn to use them in a similar manner.	Have students explain orally the mechanism used to operate clutches on some of the equipment found on the farms in the area.
A. Have a tractor in the shop that can be split easily for instructional purposes. Demonstrate the following procedure . Remove clutch assembly . Inspect clutch facings . Inspect hub & spline for wear . Examine flywheel for smoothness . Inspect release bearing-lubricate B. Review operator and/or service manuals with students locating information about the troubles listed in the content.	A. Make special note of any of the typical clutch troubles and bring into discussion any personal experiences that will benefit other students. B. Become aware of the types of information found in the owner and/or service manual brought to class.	Assign students to tractors or other equipment with clutch troubles and have them report orally or in written reports the trouble found.
		Base evaluation on report made by student for a group of defective or used clutch disks provided for this purpose.

Code - 01.0301-13

Title - AGRICULTURAL POWER TRAINS

OBJECTIVES BY UNIT	CONTENT
3.Transmissions Objective 6 Identify types,parts or components, and disassemble for repair or replacement of parts when needed.	A.Purpose .Transmitting power to the driven member of the machine .Increasing and decreasing speed or power of the machine .Controlling travel (forward or backward) of the machine B.Types--Mechanical .Sliding gear .input and output shafts parallel .input and output shafts in line .Collar shift .Synchromesh--common types of synchronizers are: .block .disc-and-plate .plain .pin
Objective 7 Diagnose and isolate malfunctions in the transmission which can be corrected through adjustment	A.Hydraulic Assist Transmission .Countershaft type .high-low speed unit .reverser unit .high-low reverse unit .Planetary type .simple .compound B.Hydrostatic drive transmission

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A .Use wall charts,teacher-made transparencies,and reference illustrations to discuss the operation and identifying the various parts of a transmission. B .Use a cut-a-way transmission if available or an open unit and demonstrate the operation of the gears,slides,etc. C .Demonstrate proper usage of transmission disassembly and repair tools. D .Have students disassemble a simple transmission and learn the parts,functions and method of disassembly.Same students should reassemble the transmission assigned them for disassembly.	A.Study references assigned by the instructor,also the charts, etc,used during class for identifying parts and components. B .Other activities might include: .Check transmission parts for wear .Drain,flush and refill the transmission gear case .Clean filters on fluid transmissions	This can be evaluated by work and report submitted and performed on on a tractor assigned in the shop.
A.Obtain a set of the 35mm slide on the transmission through purchase or loan for class use, particularly for covering the hydraulic assist and hydrostatic transmissions B.Discuss the causes of transmission noises and hard shifting as well as other problems encountered in the field or shop.	A .Develop a listing of the advantages and disadvantages of hydraulic type transmissions and drives for farm tractors. B.Discuss problems that may have been encountered with tractors having the hydraulic type transmissions.	This can be evaluated by work and report submitted and performed on a tractor assigned in the shop.

OBJECTIVES BY UNIT	CONTENT
4 .Differentials Objective 8 Describe the jobs performed by the differential and how they are accomplished.	A.Purposes .Transmits power "around the corner" to the drive axles. .Allows each drive to rotate at a different speed and still propel its own load. B.Operation .Straight forward direction .Turning corners
Objective 9 Be able to explain the type and operation of the differential locks found on today's farm tractors.	C.Differential Locks .Types .mechanical .hydraulic .automatic (no-spin) .Operation .Adjustments .bearing preload .gear backlash .Troubleshooting

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A.Remove the differential from he same tractor or shop training nit and demonstrate-- .Inspection of washers,gears and bearings for wear .Identify component parts .Explain the operation of the differential parts .Replace worn parts if necessary	A .Observe instructors demonstration.Determine what the limits of wear allowed on the various parts of the transmission.	A.The written or oral type quiz can be used to determine attaining the objective.
B .Have students disassemble a imple transmission and learn the arts,functions and method of isassembly.Same students should eassemble the transmission ssigned them for disassembly.	B .Observe how the gears operate during forward motion and when turning corners in the differential assembly.	B.A homework report could be used in testing for this objective--written or orally.
C.Stress the importance of using the manufacturer's service manuals when servicing or repairing differentials,especially when concerned with a specific type and/or accessory.	C .Disassemble a differential and study the method of part removal and identify the type of locking device, if used.	
D .Demonstrate the recommended procedure for preloading bearings and checking gear backlash. Refer to references listed at the end of this module for recommended procedures which can be notebook material.	D .Remember to USE the manufacturer's service manual as a guide in performing any work on the components.	

Code - 01.0301-13

Title - AGRICULTURAL POWER TRAINS

OBJECTIVES BY UNIT	CONTENT
5.Final Drives Objective 10 Identify the type of final drive assembly found on many items of farm equipment	A.Types .Straight axle .rigid shaft .flexible shaft .Pinion .drive located within the differential case .drive located on outer ends of final drives .Planetary .inboard .outboard .Chain
Objective 11 Determine the cause of failure from inspection of parts removed from a faulty assembly.	B.Maintenance .Causes of failure .excessive drive shaft end play .overheating .lack of lubrication C.Adjustment .Preloading bearings .Endplay
6 . Brakes Objective 12 Remove,inspect and repair the brakes on a tractor found to have no brake action during field operations.	A. Types .Types .disk .external-band .internal-expanding shoe .Adjustment

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstrate the removal and disassembly of a final drive unit performing the following: .Identity of the final drive type .Checking the various parts for wear .Proper reassembly and adjustment	A .Repeat 13 through 16 above for the final drive unit.	A.A test made up of the different tractors in the shop would determine accomplishment of this objective.
B .Discuss the various causes of failure and have students determine from inspection of defective parts what was the cause of failure. C .Repeat 19 above, for the fina drive.		B . Same method as #2
D .Using projected diagrams, ditto sheets,text illustrations, etc.,explain and discuss the various types,operations and adjustments of the Brake Systems. Refer again to the need for reference to the manufacturer's service information.	B .Inspect several makes and models of tractors to identify the type of brake assembly or mechanism used.	C .Results of the work performed would indicate completion of the objective.
E .Display old or defective parts from various tractor brake systems.	C .Inspect the parts **laid** out by the instructor for identification of failure,wear,etc.	

Code - 01.0301-13

Title - AGRICULTURAL POWER TRAINS

OBJECTIVES BY UNIT	CONTENT
7 .Power take-offs Objective 13 Solve the problem of a malfunctioning PTO of a tractor brought in for service.	A. Types .Transmission--driven .Continuous-running .Independent B.Speeds . 540 . 620 .1000 .1500
Objective 14 Remove,disassemble and repair the universal joint on the drive shaft for a PTO operated machine.	C.Parts .Universal joints .Drive shaft D.Safety precautions .Guards and shields .Disconnect when not in use .Keep hands,feet and clothing away .Lever operate at extreme angles .Shut off when working on machine
Objective 15 List six safety precautions to be observed around PTO operated equipment	

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A.Repeat 23 above,for PTO's B.Discuss the safety precautions to a good extent and bring into the discussion any local examples of accidents which have occurred that will bring "home" the real situation to individuals.	A.Check the various tractors in the service area,shop,or on home farm to determine the type, and speed of PTO used.	A. Results of the work performed would indicate completion of the objective.
C.An excellent film to use with this module, particularly in reference to bearings is---"Quite Naturally",16mm,available from, The Timken Roller Bearing Company,Canton, Ohio	B.Review the various shop references available and select a worn U-joint and disassemble and replace worn parts with new and reassemble. C.Develop a list of as many different safety precautions as can be found in the various references available.	B. Results of the work performed would indicate completion of the objective. .A written quiz should be used to test the students completing this objective.

MODULE OF INSTRUCTION

Title - AGRICULTURAL POWER TRAINS Code - 01.0301-13

RESOURCE MATERIALS

A. Books

Teacher references:

1. Machines for Power Farming, 2nd Edition, Stone and Gulvin, J. Wiley and Sons, Inc., New York, New York
2. Modern Farm Power, Promersberger and Bishop, Prentice-Hall, Inc., Englewood Cliffs, New York
3. Farm Gas Engines and Tractors, 4th Edition, Fred R. Jones, McGraw-Hill Book Co., New York, New York
4. Tractors and Crawlers, 2nd Edition, P. V. Eshelman, American Technical Society, Chicago, Illinois
5. Module #8 Agr. Machinery; Mechanical Power Transfer Systems, Ohio State University, Columbus, Ohio
6. FOS-Powertrains; General-Bearings and Seals, John Deere Co., Moline, Illinois

Student references:

1. Farm Tractor Maintenance, Brown and Morrison, The Interstate Publishers and Printers, Inc.,Danville, Ill.
2. Owner/Operators Manuals, various manufacturers of agricultural equipment
3. I&T Shop Service, Intertec Publishing Corp.,Kansas City, Mo.

B. Periodicals

1. Implement and tractor, Intertec Publishing Corp., Kansas City, Mo.
2. Farm and Power Equipment, NRFEA Publications, Inc., St. Louis, Mo.
3. American Agriculturalist, Ithaca, N. Y.
4. Hoards Dairyman, Fort Atkinson, Wis.
5. Successful Farming, DesMoines, Iowa

C. Audio-Visuals

1. Quite Naturally, 16mm film, The Timken Roller Bearing Co., Canton, Ohio
2. Handle With Care, New Departure Division, General Motors, Corp,Bristol,Conn.
3. Direct Drive Transmission, 50 color slides, The Caterpillar Tractor Co.
4. Planetary Gearing, 54 color slides, The Caterpillar Tractor Co.
5. FOS-Power train, 35mm color slides, The John Deere Co., Moline, Ill.

MODULE OF INSTRUCTION

Title - FARM MACHINERY OPERATION, MAINTENANCE AND FIELD REPAIRS	Code - 01.0301-14

DESCRIPTION:

This module is designed to prepare the student to safely operate common farm machinery. Theory of operation will be included to the extent necessary to make the adjustments and field repairs for efficient operation under farm conditions. Most of the time will be spent developing skills of operating machinery.

Preventative maintenance and its importance will also be stressed in the module. The emphasis will be on spending a little time before operation to save countless hours of lost time later.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Machinery Operation Safety	2	1
2. Performing Maintenance and Field Repair	1	9
3. Operating Farm Machinery	1	16
	4	26

Revised June, 1974

MODULE OF INSTRUCTION

Title - FARM MACHINERY OPERATION, MAINTENANCE AND FIELD REPAIRS

Code - 01.0301-14

OBJECTIVES to be obtained:

The student will be able to:

1. List orally or in writing the hazardous occupations and highway operations laws that apply to farm machinery.

2. Demonstrate, to the instructor's satisfaction, ability to use a machinery operator's manual to determine the correct procedure to follow in maintaining and performing field repair of equipment. *

3. Correctly perform recommended maintenance jobs on equipment using the service manual as a guide.

4. Perform, to the instructor's satisfaction, recommended repair adjustments on equipment, which can be made in the field using basic tools and the operator's manual for reference.

5. Demonstrate, to the instructor's satisfaction, ability to operate modern farm equipment * in a safe and efficient manner under field conditions.

* Equipment is considered to be at least one modern machine, commonly used in each of the following areas:

. Tillage
. Planting
. Cultivating
. Harvesting
. Spraying or spreading

OBJECTIVES BY UNIT	CONTENT
Unit 1.- Machinery Operation Safety Objective 1 - List the hazardous occupations and highway operation laws that apply to farm machinery	A. **Hazardous** occupation laws - latest edition B. Highway operations laws affecting farm machinery C. Safety rules to follow when operating machinery
Unit 2. - Performing Maintenance and field repairs. Objective 2 - Demonstrate to the instructor's satisfaction, ability to use a machinery operator's manual, to determine correct procedure to follow in maintaining and performing field repairs of equipment.	Material contained in the operator's manual on a self propelled machine to serve as an example of a typical manual. (Each student needs a manual on the example machine)

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture-discussion to present facts B. Resource personnel . Extension agent specializing in farm law . Law enforcement officer C. Displays of charts showing safety rules.	A. Take note of new information B. Study resource material . Rules of the road manual . Hazardous occupations law C. Gather facts from and ask questions of resource personnel D. Help set up displays	A. Written test B. Observe student actions throughout module.
A. Lecture-discussion to indicate what is in a manual and how to use it. B. Demonstration -using the manual to perform maintenance and repair jobs on the machine. C. Student practice.	A. Study sample manual. B. Assist in performing jobs during demonstrations. C. Practice using manual to perform recommended operations.	A. Students will perform given jobs using the operator's manual. B. Observe students during the operation section of the module.

OBJECTIVES BY UNIT	CONTENT
Objective 3 - Correctly perform recommended maintenance jobs on equipment using the service manual as a guide.	Maintenance Jobs on Machinery . Following recommended times from manual . Performing jobs safely . Using tools properly . Carrying out maintenance jobs
Objective 4 - Perform, to the instructor's satisfaction recommended repair adjustments on equipment, which can be made in the field using basic tools and the operator's manual for reference.	A. Types of repairs that should be attempted. . Skill of operator . Time required . Tools available . Manufacturers recommendations B. Performing repairs safely C. Using tools properly D. Repairing farm machinery

EDUCATION

Module FARM MACHINERY OPERATION, MAINTENANCE AND FIELD REPAIRS 01.0301-14

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Demonstration B. Student practice C. Field trip(s) . Farm . Machinery dealerships	Students will perform recommended maintenance jobs on equipment in school, on farm or at a dealership.	Evaluate students progress on a checksheet throughout manual. (sample attached)
A. Lecture discussions for content 1, 2, 3 B. Demonstrations of sample repairs. C. Student practice. D. Field trip(s)	A. Students take notes on information presented. B. Students assist in demonstration. C. Students will practice repairing machinery in school, on farm or at a dealership.	A. Provide test machinery in need of repair to evaluate students on. B. Evaluate students progress on checksheet throughout module.

OBJECTIVES BY UNIT	CONTENT
Unit 3. - Operating Farm Machinery Objective 5 - Demonstrate, to the instructor's satisfaction ability to operate modern farm equipment in a safe and efficient manner under field conditions.	A. Types of Farm Machinery . Tillage . Planting . Cultivating . Harvesting . Spraying and spreading B. Safety practices to observe in operating machinery. C. Efficiency factors to consider in operating machinery. D. Methods of operating machinery.

dule FARM MACHINERY OPERATION, MAINTENANCE AND FIELD REPAIRS 01.0301-14

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture-discussion B. Group concensus to determine common equipment in area. C. Filmstrip - (combines) D. Field Trip E. Student practice	A. Students will develop a list of common machines during field trips and class discussion. B. Students will read related reference material and observe visuals. C. Students will practice operating machinery. A student should successfully operate at least one machine in each of the five types.	Evaluate students as they operate equipment using a checksheet. (sample attached)

MODULE OF INSTRUCTION

Title - FARM MACHINERY OPERATION, MAINTENANCE AND FIELD REPAIRS   Code - 01.0301-14

RESOURCE MATERIALS

Books:

1. Selecting and Maintaining Field Mowers (1966), $4.00 from AAVIM
2. Plows and Plowing - $1.95 from IMS
3. Combines and Combining - 205 from IMS
4. Appropriate operator's manuals for machines used.
5. The Operation Care and Repair of Farm Machinery - John Deere
   Hazardous occupations laws, latest edition, from N.Y.S. Rural Safety Council
   NYS Labor Department, Albany and Bureau of Agricultural Education State
   Education Department, Albany, New York.

Bulletins:

Job operation sheets in agricultural mechanics - $.45 from IMS

Periodicals:

Farm Equipment periodicals should be helpful

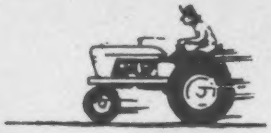
Audiovisuals:

Combines, Principles of Operation (39 slides) IMS
Safety Charts available from NYS Rural Safety Council and machinery manufacturers

SETUPS FOR UPSETS

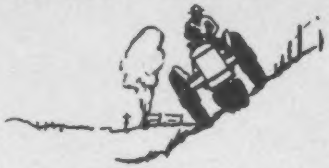
Recognize Hazards—Avoid Accidents

SPEED



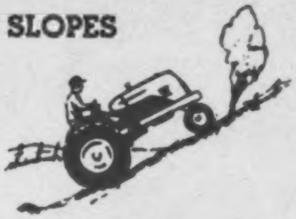
Driving too fast is a factor in most tractor upsets. Many occur while tractor is being driven to or from work. Slow down and get there!

CROSSING SLOPES



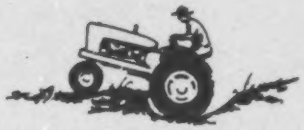
A hole, bump, or quick turn can bring tragedy on a slope. Be extra careful if the slope is too steep. Don't try to farm it!

UP SLOPES



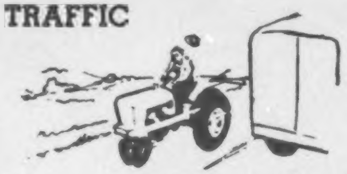
Backward upsets are apt to happen when going uphill. If you have to go up a really steep one, back the tractor up the slope!

DITCHES



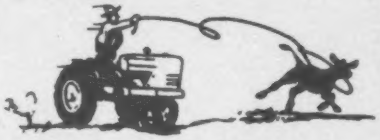
This tractor may tip backwards when power is applied. Sideways upsets often happen in ditches. Avoid steep banks. Cross ditches where banks have gradual slope.

TRAFFIC



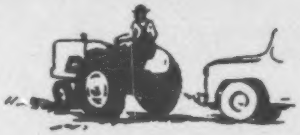
High-speed traffic and slow-speed tractors don't mix—safely. But more operators are killed on public roads by tractor upsets than by collisions. Avoid heavy traffic!

MISUSE



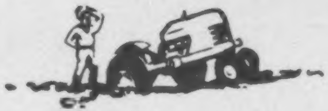
Many deaths result from running errands, herding cattle, or just plain horseplay on tractors. Get a horse! Use your tractor for the jobs it's designed to do.

HIGH HITCH



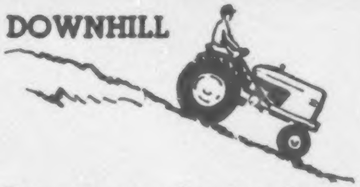
Hitching to the axle or seat bracket can cause a backward upset. Don't do it! Never attempt to pull a load with the drawbar removed.

MUD



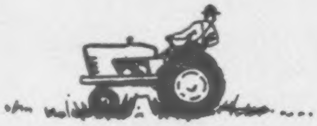
Something will turn if power is applied. If the wheels stick, the chassis will revolve around axle. When you can't back out, get help.

DOWNHILL



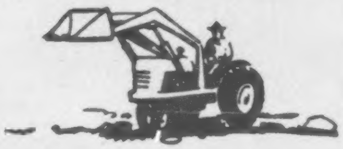
Down steep grades, there is more weight on front wheels — more chance of an upset. Do not try to handle heavy loads. Always leave your tractor in gear!

HIDDEN OBSTACLES



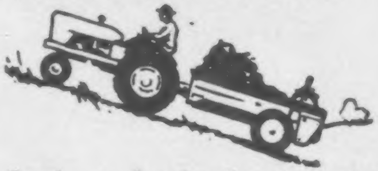
A big tractor tire has lots of "bounce." A hidden log, stump, or stone can throw you. Be alert, slow down for tall weeds or grass.

LOADS ON FRONT



A front end loader is a laborsaver. But it makes a tricycle tractor easy to tip. Use loader with care. Add rear wheel weights.

LOADS ON DRAWBAR



Loads on the drawbar increase the chances of a backward upset. Add front end weights for balance. Handle tractor with care on slopes.

SAFETY PRECAUTIONS

Many hours of lost time and much suffering is caused by the failure to practice simple safety rules.

IT IS TOO LATE TO REMEMBER WHAT SHOULD HAVE BEEN DONE AFTER THE ACCIDENT HAS HAPPENED.

1. See Tractor Operator's Manual.
2. Do not operate in unstable spots or where bank "cave ins" are possible.
3. Do not swing and strike solid objects.
4. Keep bystanders or others out of reach.
5. Do not work over companion help in trench.
6. Never travel across frozen slopes with crawler type tractor if at all possible.
7. Always disengage transmission before leaving machine.
8. Always ground units before leaving machine.

DO'S

1. Use "Series 3" Motor Oil in engine crankcase.
2. Check every 10 hours after tractor has set long enough for oil to drain back.
3. Replace filter and refill engine crankcase every 100 hours under normal conditions, more often if necessary. Have engine at normal operating temperature when draining. Use sae 30 above 32 F., Use sae 20w from 0 F. to 32 F., and use low below 0 F. and below.
4. Crank engine for 15 seconds with the fuel shut off before turning fuel on. Start engine at ½ throttle.
5. Take advantage of the features of **specified** filter elements.
6. Make certain oil pressure gauge indicates the circulation of oil.
7. Use a good grade of No. 2 diesel fuel suppled by a reputable oil company.
8. Drain sediment from fuel tank and filters daily.
9. Replace fuel filters with Allis-Chalmers filters after 500 hours or when fuel pressure drops below 8 psi.
10. Check anti-freeze solution to provide adequate protection in freezing weather. If draining in freezing weather, make certain cooling system is completely drained.
11. Deep fan, water pump and generator fan belts properly adjusted.
12. Check coolant level daily.
13. Operate unit with temperature gauge within operating range.
14. Check electrolyte solution in batteries daily.
15. Check electrical cables for loose connections or frayed insulations.
16. Keep battery terminals clean and tight.
17. Torque pre-cleaner (Farr type) to 5 ft. lbs.
    (TIGHTEN HAND TIGHT AND GIVE 1-½ more turns.)
18. Turn off master switch before cleaning, repairing, disconnecting or connecting any heavy electrical cables.
19. If engine does not start in 30 seconds, allow starter to cool two minutes before attempting to start.
20. Keep engine clutch adjusted at all times.
21. Throttle back engine when shifting gears of starting load.
22. Stop engine when prolonged idling periods would occur.

DO'S (continued)

23. Keep tracks properly adjusted.

24. Replace with **specified** elements after the first 50 hours and every 500 hours thereafter the engine clutch (oil type), transmission, steering clutches and brakes.

25. Change oil in engine clutch, transmission, bevel gear, brakes and steering system with sae 10, lubricating oil every 1000 hours.

DON'T

1. Shorten engine life by using other than recommended lubricants.
2. Overfill crankcase oil sump.
3. Use engine crankcase oil beyond its capability to hold contaminants in suspension.
4. Start a cold engine and run at high idle.
5. Use any other than specified oil filter elements.
6. Operate tractor unless oil gauge shows pressure.
7. Use a poor grade or diesel fuel in high speed engine and lose performance.
8. Allow sediment to plug fuel filters.
9. Allow oil to enter close fitting pump parts.
10. Wait until it's too late to check anti-freeze.
11. Allow belts to become worn due to slippage.
12. Allow coolant to drop below radiator tubes, remove cap while temperature gauge is in upper portion.
13. Operate with a cold engine.
14. Allow electrolyte level to drop below separators.
15. Operate with loose, worn or frayed battery cables.
16. Lose voltage through poor connections.
17. Allow dirt to enter engine.
18. Short out electrical systems.
19. Overheat starter which shortens life.
20. Allow clutch to slip because of low pressure.
21. Run a cold engine any longer than necessary.
22. Allow loose or tight tracks to cause premature wear.
23. Run with contaminated oil.
24. Operate beyond recommended change intervals.

CHECKSHEET - FARM EQUIPMENT OPERATION MAINTENANCE AND FIELD REPAIR

Machine		(Name)																							
	Maintenance																								
	Field Repair																								
	Safe Operation																								
	Efficient Operation																								
	Maintenance																								
	Field Repair																								16
	Safe Operation																								
	Efficient Operation																								

MODULE OF INSTRUCTION

Title - SETTING UP AGRICULTURAL MACHINERY Code - 01.0301-15

DESCRIPTION:

Students will demonstrate an ability to correctly assemble new equipment and prepare it for sale and delivery. Efficient assembly procedure and techniques with the limits of quality control and safety will be stressed in this module. Students will be involved with hardware identification and parts layout are included. Correct installation and alignment of pulleys and belts, chains and sprockets, and shafts and gears will be covered.

Proper adjustment, correct lubrication and pre-delivery service in the shop and under field conditions will be emphasized.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Assembly Manual Use	1	1
2. Hardware Identification and Terminology	1	2
3. Techniques of Machine Assembly	1	16
4. Check of Common Assembly Errors	1	1
5. Lubricants and Lubrication	1	1
6. Pre-delivery Service	1	3
	6	24

Revised January, 1975

MODULE OF INSTRUCTION

Title - SETTING UP AGRICULTURAL MACHINERY

Code - 01.0301-15

Objectives to be obtained:

The student will be able to:

1. Understand the information and procedure outlined in the assembly manual for a machine to be set-up in the shop and meet industry standards.

2. Use the assembly manual as a guide and identify the various parts of the machine needed for proper assembly, to the satisfaction of the instructor.

3. Demonstrate an understanding of terms and illustrations used in the assembly manual and discuss the machine and procedure with an industry representative intelligently.

4. Correctly assemble a new machine to manufacturers' specifications following the procedure outlined in the assembly manual using the illustrations, parts and assemblies included, shop tools and equipment available.

5. Identify common assembly errors on machine previously assembled, prior to and after, they have been started so they can be corrected to meet industry standards.

6. Select the proper lubricant for a machine from the stock available, use it for the purpose it was designed for meeting manufacturers' recommendations.

7. Use the check list and perform the necessary adjustment, as outlined in the manual, prior to delivery of the machine to meet the manufacturers' standards.

8. Demonstrate, by completing a report form (which establishes the responsibility in case of failure as the mechanic, dealer or manufacturer) on the purpose of pre-delivery service.

AGRICULTURAL

Module SETTING UP AGRICULTURAL MACHINERY 01.0301-15

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Assembly manual use. Objective 1 Understand the information and procedure outlined in the assembly manual for a machine to be set-up in the shop and meet industry standards.	A. Machine Assembly manual . Study the operators manual thoroughly to understand the machines operation, its adjustments and servicing requirements. Included: . machine specifications . operation . adjustments . Lubrication . attachments . trouble-shooting . setting-up instructions

EDUCATION

Module SETTING UP AGRICULTURAL MACHINERY 01.0301-15

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Prepare a general outline ditto sheet for students.	A. Review ditto sheet outline provided by instructor and the assembly manual provided with machine assigned for set-ups.	A. Have students explain orally their interpretations of information found in an assembly manual.
B. Review with students an assembly manual furnished with a piece of equipment to be set-up in the shop.	B. Obtain other manufacturers' assembly manuals for comparison	B. Check students work at the start of assembly to determine their ability to follow the information given in the manual.
C. Emphasize the important sections of the manual especially the part on bolt hardness, printed information along with the illustrations and safety.		

OBJECTIVES BY UNIT	CONTENT
Unit 2 - Hardware identification and terminology Objective 2 Use the assembly manual as a guide and identify the various parts of the machine needed for proper assembly, to the satisfaction of the instructor.	A. Common Parts and Assemblies . Items that are common to all models . Items that are common to certain models . Attachment parts . Optional parts . Special Parts
Objective 3 Demonstrate an understanding of terms and illustrations used in the assembly manual and discuss the machine and procedure with an industry representative intelligently.	A. Terms Example - Baler . Shipping bundle . Tongue latch . Spindle . Control support . Reinforcing washer . Windguard . Tongue . Feed Arm

Module SETTING UP AGRICULTURAL MACHINERY 01.0301-15

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Review set-up manuals and prepare a list of items or hardware that is common to the particular machine to be set-up. B. Identify the common assemblies for students to become acquainted with the new machine.	A. Become familiar with the items the instructor has listed as common to the machines. B. Be able to identify the common assemblies on a new machine brought in for set-up.	A. Use a short quiz of items laid out on the floor for students to identify. B. Ask students at random to identify assemblies as students assemble new machine.
Objective 3 A. Review manuals for common terms used in detailing set-up or identification of machine parts. B. Use text American Society of Agricultural Engineer's Handbook for defining other common terms.	(Same as above)	A. Use a matching quiz for students to learn the terms and meanings.

Code - 01.0301-15

Title - SETTING UP AGRICULTURAL MACHINERY

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Techniques of machine assembly Objective 4 Correctly assemble a new machine to manufacturers' specifications following the procedure outlined in the assembly manual using the illustrations, parts and assemblies included, shop tools and equipment available.	A. Uncrating the new machine . Remove straps and nails that would be hazard to the mechanic or machine. . Use hoists, jacks, cranes to lift, tip, etc. the machine into operating position. . Assemble those parts as per instructions to make the machine portable. . Continue setting up machine as per instructions and illustrations show.
Unit 4 - Check of common assembly errors Objective 5 Identify common assembly errors on machines previously assembled, prior to and after, they have been started so they can be corrected to meet industry standards.	A. Corrections to be made - . Oil on over-running clutch dogs . Belts installed backward . Rusted shafts non-movable sheaves . Tension springs not aligned . Sheaves not aligned . Idler pulley hinge bolts too tight . Wheel hub bolts not tight . Rust on belt surface of sheaves . Wire harness not threaded correctly . Dried-out oil-impregnated bolts

Module SETTING UP AGRICULTURAL MACHINERY 01.0301-15

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A . Demonstrate and review the procedures given in the assembly manual for setting-up the new machine. B . Emphasize Safety constantly during the assembly procedure.	A . Follow procedures outlined in assembly manual and set-up the machine assigned. B . Practice and observe safety rules throughout assembly of machine.	A. Observe students progress and check chart of their progress.
A . Review machine assembly manuals with local dealers servicemen for errors typical in assembly of their new machines. B . Discuss the lists of such assembly errors with students;also have local dealer servicemen talk to class about such errors found in the field after delivery. C . Have students switch machines after assembly and check for any possible errors in assembly.	A . Use lists provided by instructor for checking machine assigned for set-up and correct all errors. B . Exchange machines with other students for checking possible assembly errors.	A . Check students ability to recognize errors on machine assigned as well as on other machines. B . Have students list the errors found in the new equipment assembled.

Code - 01.0301-15

AGRICULTURAL

Title - SETTING UP AGRICULTURAL MACHINERY

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Lubricants and lubrication Objective 6 Select the proper lubricant for a machine from the stock available, use it for the purpose it was designed for meeting manufacturers' standards.	A. Types of Friction . Dry . Viscous B. Four groups of lubricants . Crankcase oil . Gear oil . Hydraulic oil . Greases C. API crankcase oil classifications . Eight catagories . SA . CA . SB . CB . SC . CC . SD . CD D. Types of lubricating greases . The three catagories . lime soap - chassis grease . soda soap - wheel-bearing grease . lithium soap - multi-purpose grease

EDUCATION

Module SETTING UP AGRICULTURAL MACHINERY 01.0301-15

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Pass around cans of different brands and API classification and raise the question, "Which oil would you use?"	A. Become familiar with the new API classifications printed on cans of motor oil in stock.	A. Check students knowledge of lubricants with a quiz developed from the material covered in class. Refer to 4-H Tractor Program Units on lubrication.
B. Show the students samples of the different types of oils and greases.	B. Observe the reaction of the various greases to heat applied to samples in the demonstration by the instructor.	
C. Show the class worn engine parts and machinery parts caused by varnishing, sludge, and corrosive acids.	C. Check with a microscope, smears of unused and used oil and/or grease placed on a slide.	
D. Pour the oil drained from an engine through a filter and show the sludge deposited on the filter.	D. Inspect the surface of a piece of metal under the microscope noting the roughness of the surface.	
E. Place a sample of a lime soap, soda soap, and lithium soap grease on a glass plate. Apply heat under each sample of grease noting the breakdown of the grease samples.		

OBJECTIVES BY UNIT	CONTENT
Unit 6 - Pre-delivery service Objective 7 Use the check list and perform the necessary adjustment as outlined in the manual prior to delivery of the machine to meet the manufacturers' standards.	A. Four Important Steps - . Receiving - . inspection for damage or shortage . Warehousing and Storage . stored carefully . protected from deterioration . Preparing for Delivery . customer satisfaction . performed thoroughly and properly . Delivering . give customer instructions . operation . field adjustment . maintenance
Objective 8 Demonstrate, by completing a report form (which establishes the responsibility in case of failure as the mechanic, dealer or manufacturer) the purpose of pre-delivery service.	A. Purpose of Pre-delivery . To assure customer of machines adjustment to specifications and in first class condition. . To establish the date of delivery so that the full term warranty is assured to the customer. . To be used as guide for - . checking every adjustment . giving information to customer on operation . adjustment and maintenance

Module SETTING UP AGRICULTURAL MACHINERY 01.0301.15

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Explain the factors involved in the four steps of the pre-delivery service. B. Review manuals (assembly, owner's and/or pre-delivery) for the specific machine with students. C. Have a local dealer explain the importance of this service from his standpoint to the students. D. Visit a local dealership and observe the performance of receiving, warehousing, pre-delivery, and delivery service.	A. Become acquainted with the important steps to the pre-delivery service. B. Observe the actual operations taking place at a local dealership.	A. Have students explain their understanding of these four steps after the visit to a dealership.
A. Demonstrate the use of the check list (Pre-delivery form) and go over each item referring to the appropriate manual for specific details for the adjustment, etc. B. Have students role play the part of a dealer serviceman and a customer in explaining the instructions for the operation, field adjustment and maintenance required on the part of the customer.	A. Use the pre-delivery check list and appropriate manuals for doing this service correctly. B. Take the part of a dealer serviceman and give the instructions to a fellow student (the customer) on the essential factors, operation, adjustment and maintenance.	A. Check the students work with check list as to meeting industry standards. B. Observe the student in role-playing the part of a dealer serviceman giving instructions to a customer.

MODULE OF INSTRUCTION

Title - SETTING UP AGRICULTURAL MACHINERY Code - 01.0301-15

RESOURCE MATERIALS

A. Books - 1. Teacher references
  a) Module #7 - Agricultural Machinery Assembly and Lubrication, The Ohio State University, Columbus, Ohio 43212
  b) Manual - Management Course in Dealer Service Operations, Massey-Furgerson Inc., Indianapolis, Indiana 46206
  c) Manual - Service Management Handbook, J.C. Case Co., Racine, Wisconsin 53401
  d) Manual - Service Center Management, International Harvester Company, Chicago, Illinois 60601

2. Student References
  a) Manufacturers' Owner/Operator's manuals

B. Bulletins -Special Reference materials provided by Mr. Edward F. Smucker, Training Center Supervisor, New Holland Division, New Holland, Pennsylvania 17567

C. Periodicals -

1. Teacher references
  a) Farm Power and Equipment, National Farm Power and Equipment Dealer's Association.
  b) Implement and Tractor, Technical Publications Inc.

D. Audiovisuals -

1. Steps to Service Shop Profits, New Idea Farm Equipment Co., Coldwater, Ohio 45828

2. Other similiar slide or film strip sets available from various manufacturers' service departments and/or local dealerships.

MODULE OF INSTRUCTION

Title - AGRICULTURAL EQUIPMENT REPAIR

Code - 01.0301-16

DESCRIPTION:

Experience in the service, adjustment and simple repair of common agricultural equipment will be basic to this module. Classroom will involve suitable texts and how-to-do visuals. The student will correctly use the tools appropriate for such repair on a farm or other agricultural establishment.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Determining Machine components and Specifications	2	1
2. Clean Machine Prior to Repairs		1
3. Recondition the Machine		18
4. Servicing the Machine	1	2
5. Running-in Reconditioned Machine		1
6. Painting Machine if Needed	1	2
7. Cutting Cost of Repairs	1	
	5	25

Revised January, 1975

MODULE OF INSTRUCTION

Title - AGRICULTURAL EQUIPMENT REPAIR

Code - 01.0301-16

Objectives to be obtained:

The student will be able to:

1. Identify the machine by make, model and serial number using the owner/operator's manual and record this information legibly.
2. Name the parts of the components of the machine, by using the owner's or parts manual, for the dealer's partsman when having to order the replacement parts.
3. Orally explain the function of machine parts or components during class discussion to the instructor's satisfaction.
4. Recognize and identify the driving mechanism of the machine brought in for repairs by indicating the safety hazards that exist, to the instructor.
5. Separate and/or remove machine attachments from the main machine using tools and equipment in the school shop and store them temporarily, safely and correctly as per shop standards.
6. Use a steam cleaner and/or other cleaning equipment in the shop area provided for this purpose and clean the machine throughly prior to repairs.
7. Determine the extent of repairs needed by the machine through visual inspection in the shop, identify the worn, broken or damage parts for the instructor.
8. Remove or disassemble the parts from the machine with tools provided in the shop within the time standards set by industry.
9. Rebuild parts or components of machine by arc welding, oxy-acetylene welding or drilling new holes, etc. with equipment in the shop to his and the instructor's satisfaction.
10. Reinstall the new, rebuilt or reconditioned parts on the machine in the shop within the time standards set by industry.
11. Select and use the lubricants as recommended in the owner/operators manual and those available to him in the shop with tools that are also available for this purpose prior to starting the machine.
12. Make the necessary adjustments to the machine following the instructions in the owner/ operators manual to within the manufacturer's specifications.
13. Start and run the machine, check for any misaligned parts, over-heating bearings or leaking oil or grease seals after the reconditioning and servicing in the shop under the supervision, observation and approval of the instructor.

Objectives to be attained: (Continuation)

14. Properly prepare and apply paint materials to the completely reconditioned and prepared machine in the shop using tools and equipment available to his and the instructor's satisfaction.

15. Cut the cost of repairs on machinery using procedures developed in class and show results of savings at the end of the year tax report.

AGRICULTURAL

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301-16

Agricultural Mechanics

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Determining machine components and specifications Objective 1 Identify the machine by make, model, and serial number using the owner/operator's manual and record this information legibly.	A. Owner/operator's manual . Introduction section . location of name plate . spaces provided for recording model and serial number . Importance of correct model and serial number information
Objective 2 Name the parts or the components of the machine by using the owner's or parts manual for the dealer's partsman when having to order the replacement parts.	A. Identification of parts B. Function of parts Example: Mower-types . Trail . Integral rear -mounted . Side-mounted
Objective 3 Orally explain the function of machine parts or components during class or shop discussions to the instructor's satisfaction.	A. Parts — Function Example Frame — The part that supports the drive and cutter bar mechanism. Drag bar — That part which extends from the frame to the yoke. Yoke — That part to which the cutter bar is hinged.

Agricultural Mechanics

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Obtain machine for repair by each 2 students.	A. Provide a machine for reconditioning (if possible)	A. Check sheet • Indicate student effort in obtaining machine for reconditioning • Student's obtaining owner/operator's manual • Legibility of recorded information from the machine name place.
B. Make certain the owner/operator's manual is available for each machine.	B. Supplying owner/operator's manual for same machine, obtain such manual from the local dealer or from manufacturer.	
C. Demonstrate the use of the manual for properly locating the manufacturer's identification plate on machine.	C. Using manual locate and record the manufacturer's identification information.	
A. Review text, Farm Machinery and Equipment pages 293 to 294.	A. Use text and become acquainted with nomenclature attached to parts of machine.	A. Use a ditto of machine parts and have student identify or indicate on the picture what the part name is of each component.
B. Prepare transparencies from parts manual or make ditto sheets review and also writing in names of parts, components, etc.	B. Learn what the function of these parts or components do in the actual operation of the machine.	B. Determine in an oral questioning what the functions of the part of the machine are.
C. Go over machine pointing out the parts and help students identify by name.		
A. Ask questions of students and help them explain the functions of the parts or components.		

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301-16

Agricultural Mechanics

OBJECTIVES BY UNIT	CONTENT
Objective 4 Recognize and identify the driving mechanism of the machine brought in for repairs by indicating the safety hazards that exist to the instructor.	A. Power units . Clutch controls . Switches B. Drive lines or shafts . Shielding C. U-joints . Safety collars . Alignment
Objective 5 Separate and/or remove machine attachments from the main machine using tools and equipment in the school shop and store temporarily, safely and correctly as per shop standards.	A. Separate units or components Example: Bale thrower on pick-up baler . Proper connecting of lifting or jacking devices for balance. . Removal of driving devices that connect to main machine. . Temporary storage or supporting procedures. . Safety factors

EDUCATION

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301-16

Agricultural Mechanics

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Demonstrate methods of connecting and disconnecting power source. B. Point out and explain the transmission of power from its source to end use. C. Discuss the need for safety collars or shielding around U-joints, slip clutches and other parts of the drive line. D. Refer to some accidents that have occurred in local area.	A. Identify the power driving controls on the machine he is repairing. B. Check to see that all shields or guards are in place on machine. C. Check for proper alignment of the U-joints in the drive lines.	A. Have student demonstrate his knowledge of the controls of the machine power driving mechanism by explaining it to his fellow students.
A. Explain the use of the owner/operator's manual in describing the attachment removal and reattaching procedure. B. Point out the various power connecting arrangements using overhead transparencies or the machines in the shop. C. Demonstrate various balancing methods in lifting or jacking operations. D. Emphasize the safe use of the tools or equipment being used.	A. Follow instructions in manual for removal of attachments when preparing to recondition machine.	A. Check students' work in removal of attachments by observation, grade according to ability to accomplish compared to methods demonstrated by instructor.

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301.16

Agricultural Mechanics

OBJECTIVES BY UNIT	CONTENT
Unit 2 - Clean machine prior to repairs **Objective 6** Use a steam cleaner and/or other cleaning equipment in the shop area provided for this purpose and clean the machine thoroughly prior to repairs.	A. Steam cleaner operation . Connecting to water supply . Fuel supply . Electrical source . Safety . Method of manipulation of nozzle B. Cold solvent washer tank . Electrical connection . Safety
Unit 3 - Recondition the machine **Objective 7** Determine the extent of repair necessary to the machine by visual inspection in the shop, identifying the worn, broken or damage parts for the instructor.	A. Visual inspection . Worn parts . Broken parts . Loose bolts . Frayed belts . Leaking grease seals . Misaligned shafts
Objective 8 Remove or disassemble the parts from the machine with tools provided in the shop within the time standards set by industry.	A . Parts removal . Use of proper tools . Remove only necessary parts or components

EDUCATION

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301.16

Agricultural Mechanics

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Demonstration of connecting the steam cleaner to water supply, filling with proper fuel, and electric outlet. B. Stress the safe use and indicate the hazards involved in using cleaner. C. Demonstrate the proper method of manipulation of the gun nozzle for most efficient and effective cleaning (same procedure for cold washer)	A. Use steam cleaner to thoroughly clean machine brought into shop for repair. B. Clean small parts or components in cold washer tank prior to making repairs.	A. Evaluate student performance by observation and grade in accordance with standards of proficiency established for job of cleaning equipment.
A. Display and identify worn, broken and damaged parts, belts, shields, etc. B. Describe causes of failure of parts to students and explain the corrective maintenance.	A. Visually locate worn, broken and damaged parts. B. Indicate the probable cause of failure.	A. Check parts identified by student as needing repair, replacements or adjustment and grade according to standards set by industry.
A. Demonstrate the proper tools for the various jobs to be performed on equipment.	A. Disassemble machine parts that are to be rebuilt, replaced or renewed.	A. Observe the student's ability to remove only parts necessary and grade on basis of industry standards.

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301.16

Agricultural Mechanics

OBJECTIVES BY UNIT	CONTENT
Objective 9 Rebuild parts or components of machine by arc welding, oxy-acetylene welding or drilling new holes, etc. with equipment in shop to his and the instructor's satisfaction.	A. Rebuilding parts of components • Use of arc welder • Use of oxy-acetylene equipment • Drill press or portable drill • Other available tools
Objective 10 Reinstall the new, rebuilt or reconditioned parts on the machine in the shop within the time standards set by industry.	A. Installation of parts • Proper alignment • Fastened securely • Use of correct tools
Unit 4 - Servicing the machine **Objective 11** Select and use the lubricants as recommended in the owner manual and available to him in the shop with tools also available for this purpose prior to starting machine.	A. Lubrication • Selection of proper lubricant • oil • grease • chassis - lime soap • wheel bearing - soda soap • multi-purpose - lithium soap • Equipment • oil measure • grease gun • hand • pressure
Objective 12 Make necessary adjustments to the machine following the instructions in the owner's manual to within the manufacturing specifications.	A. Adjustments • Refer to operating adjustments section of owner/operator's manual • read printed information as well as referring to picture

EDUCATION

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301.16

Agricultural Mechanics

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Demonstration of hard facing of parts. B. Demonstration of brazing on thin metal. C. Demonstration of the removal of broken studs and retapping threads of hole.	A. Perform the necessary repair or rebuilding tasks on the machine being reconditioned.	A. Observe the student's ability to do the job required efficiently, safely and with the least amount of supervision.
A. Stress cleanliness and safety. B. Explain the importance of securing parts or components.	A. Properly install new or replacement parts.	A. Evaluate on the basis of proper installation and machine operation following completion of reconditioning.
A. Review the information contained in the owner/operator's manual on lubrication. B. Demonstration the proper method of equipment use	A. Use manual for machine and follow recommended lubrication procedure.	A. Observe the student in performing the job of lubrication and grade according to standards set by industry. B. Check student's cleanliness and housekeeping in use of tools and/or equipment
A. Demonstrate the use of the owner/operator's manual by relating from a specific manual to the particular machine.	A. Using manual supplied for his machine follow instructions and perform the adjustment and check for proper function.	A. Check for the proper operation following adjustments made by student.

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301.16

Agricultural Mechanics

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Running-in-the reconditioned machine Objective 13 Start and run the machine, check for any misaligned parts, overheating bearings, or leaking seals after the reconditioning and servicing in the shop under the supervision, observation and approval of the instructor.	A. Importance of machine run-in . Checking for the following: • proper alignment of parts, shafts, etc. • overheating bearings • leaking oil or grease seals . clearances of specific part adjustments
Unit 6 - Painting machine if needed Objective 14 Properly prepare and apply paint materials to the completely reconditioned machine in the shop using tools and equipment available to his and the instructor's satisfaction.	Review A. Painting agricultural equipment (Refer to 01.0305.04 Painting Tractors and Equipment)

EDUCATION

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301.16

Agricultural Mechanics

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Refer to specific manufacturer's and/or dealer's recommendations for run-in procedure. B. Use dealer service personnel to explain results of having run-in new or reconditioned machines.	A. Prepare and run machine for a reasonable time and make checks of the parts for alignment, overheating bearings and leaking seals.	A. Indicate on progress chart the completion of this necessary procedure.
A. Briefly cover information contained in the module listed in content. B. Demonstrate those skills needed by the student to do a better job.	A. Prepare the machinery for painting if needed. • Prepare paint • Use equipment for painting • Practice good housekeeping • Display proper safety practices	A. Check the progress of the student in doing this job and also the finished work to compare with industry standards.

AGRICULTURAL

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301.16

Agricultural Mechanics

OBJECTIVES BY UNIT	CONTENT
Unit 7 - Cut cost of repairs Objective 15 Cut the cost of repairs on machinery using procedures developed in class and show a savings at the end of the year tax report.	A. Machinery cost cutting tools . Your operator's manual . proper operation . maintenance and servicing . earlier replacement of worn parts . A planned lubrication program . follow lubrication chart in Operator's manual . use lubrication guide provided by petroleum dealers . On-time maintenance . set up specific times for the maintenance on machines . doing own work where possible

EDUCATION

Module AGRICULTURAL EQUIPMENT REPAIR 01.0301.16

Agricultural Mechanics

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Review the manufacturer's manuals with students stressing the importance of following recommendations for operation, maintenance and lubrication.	A. Develop schedules for machine maintenance.	A. Check student's progress on basis of preparation of maintenance schedules.
B. Help develop schedules for maintenance, repairs, etc.	B. Obtain petroleum company lubrication charts for machines in use at home.	B. Also the number of lubrication charts prepared on home machines.
C. Obtain petroleum dealers charts and encourage students to also obtain sufficient charts for their machinery.	C. Determine actual cost of machinery repairs at end of year tax report.	C. Quiz on repair cost problems.
D. Refer to bulletin reference #2a, for cost of repairs of specific machines, also use reference #1d for more detail.		

RESOURCE MATERIALS

A. Books -

1. Teacher references
   - (a) Principles of Farm Machinery, Bainer, Kepner, Barger-J. Wiley & Sons.
   - (b) Shop Work on the Farm, Mark M. Jones, McGraw-Hill Book Co.
   - (c) Engineering Bulletin FT-53A, American Oil Co., Chicago, Ill.
   - (d) American Society of Agricultural Engineer's Handbook.

2. Student references
   - (a) Machines for Power Farming, Stone and Gulvin, J Wiley & Sons.
   - (b) Farm Machinery and Equipment, Harris P. Smith, McGraw-Hill Book Co.
   - (c) Farm Shop Skills, Sampson, Mowery, Kugler, American Tech. Soc.
   - (d) The Operation, Care and Repair of Farm Machinery, The John Deere Co.

B. Bulletins -

1. Teacher references
   - (a) Various Cornell publications on repairs
     Example: Plows-Adjustment
     Mowers-Repair & Adjustment

2. Student references
   - (a) 4-H Tractor Program Manuals 1-4.
   - (b) Machinery Cost Guide, American Oil Co., Chicago, Ill.

RESOURCE MATERIALS (cont'd)

C. Periodicals -

1. Teacher references
   (a) Farm Power and Equipment, National Farm Power and Equipment Dealers Assoc.
   (b) Implement and Tractor, Technical Publications & Inc.

2. Student references
   (a) American Agriculturalist, Ithaca, New York
   (b) Hoard's Dairymen

D. Audiovisuals -

Various--obtainable from manufacturers service departments and/or local equipment dealers. (Too broad and varied to identify due to the scope of this module.)

MODULE OF INSTRUCTION

Title - AG HYDRAULIC SYSTEMS Code - 01.0301-17

DESCRIPTION:

This module is designed to orient the student on the broad and complex subject of hydraulic systems. The student will identify sophisticated components, explain their operation, and develop an ability to efficiently and accurately troubleshoot malfunctions. He will efficiently utilize test equipment to pinpoint the location of malfunctions. After locating the malfunctioning component, he will accurately repair the assembly.

Due to the complexity of the hydraulic components, each manufacturer utilizes unique designs. These designs require specific procedures to follow in order to correctly and efficiently disassemble and reassemble components. As a result of this complexity, this module does not attempt to outline each procedure. For this disassemble and reassemble procedure and specific specifications one should refer to the manufacturers shop manual.

Units	Time Allocation	
	Class	Other
1. Principles of Hydraulics	1	1
2. Identifying Components and Functions	6	3
3. Pretesting Procedure	1	2
4. Testing Procedure	2	8
5. Repairing Components	—	6
	10	20

Revised June, 1974

MODULE OF INSTRUCTION

Title - AG HYDRAULIC SYSTEMS Code - 01.0301-17

Objectives to be obtained:
The student will be able to:

1. Explain the basic principles of a hydraulic system.
2. Identify all major components of a hydraulic system and describe their functional operation.
3. Describe pretesting procedure and identify pertinent information necessary for efficient troubleshooting.
4. Recognize characteristics of operation which are causing malfunctions.
5. Select proper test equipment to pinpoint malfunctions.
6. Perform a systematic troubleshooting procedure.
7. Efficiently use available test equipment.
8. Efficiently check the pump suction strainer and identify causes of malfunction.
9. Efficiently isolate and perform tests on the pump and main relief valve and identify causes of malfunctions.
10. Isolate and perform tests on cylinders and identify causes of malfunction.
11. Efficiently isolate and perform tests on control valves and identify causes of malfunctions.

AGRICULTURAL

Module AG HYDRAULIC SYSTEMS 01.0301-17

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Principles of Hydraulics Objective 1 - Explain the principles of hydraulics	A. Define Hydraulics B. Advantages of Hydraulics C. Basic principles . Distribution of force of liquids . Mechanical advantage compared with hydraulic advantage D. Heat and hydraulics E. Horsepower transmission requirements F. Open and closed circuits G. Hydraulic Diagrams . Pictorial . Schematic . Block H. Oils . Types . mineral . vegetable . Properties and characteristics . pour point . flash point . viscosity . non-corrosive . Oil additives . anti foam . rust inhibitor . lubrication for close tolerance areas . Basic Causes of Malfunctions . abrasive contaminants . non-abrasive contaminants

EDUCATION

Module AG HYDRAULIC SYSTEMS — 01.0301-17

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
Lecture discussing . Introduction of hydraulics . Diagrams . Oils	A . Read hydraulic diagrams-schematic block and/or pictorial B . Review hydraulic oil specifications from manufacturers.	Written A . Draw a schematic diagram of a typical hydraulic system. Label each component. Describe function of each component.
Overhead Transparencies or slides showing . oil specs . diagrams-schematic	C . Maintain terminology list during lecture and record definitions.	B . Compare oil specifications of oils available locally - compare with mfgr's specs. Select best oil from local source to meet mfgr. specs.
Cutaway of Components Sample components	D . Find samples of abrasive and non abrasive contamination from a hydraulic system in use.	C . Select terminology list and define each.
Hand out sheets illustrating oil specifications		Manipulative On an assigned unit (tractor-loader) trace the oil flow. Draw a schematic of the flow and components starting at the reservoir. Identify the components.

OBJECTIVES BY UNIT	**CONTENT**
Unit 2 - Identifying Component and Functions Objective 2 - Identify each major hydraulic component, and describe its functional operation	A. Reservoirs . Construction of . Components of and purpose of . main body . suction and return outlet . filtercap and breather . level gauge . drain . baffle . Design of . recommended capacity
	B. Hydraulic Lines . Types - . rubber . steel tubing . copper tubing . pipe-galvanized and black . stainless tubing . plastic tubing . Correct installation procedures
	C. Types of fittings . Flare . two piece, three piece and inverted . Flareless . regular ferrule, inverted ferrule, threaded sleeve and double compression . Installing procedure

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture and discussion (also handout sheets on) components types of reservoirs lines fittings oil coolers pumps control valves relief valves cylinders parkings and seals accumulators hydraulic motors couplers	A. Construct a typical oil reservoir-incorporate all necessary components	Draw a typical reservoir Label each component Define purpose of each component
B. Cutaways of Components	B. Identify various types of lines on an assigned unit Note where used Make up hydraulic circuit of lines and components using correct installation procedure Install each type of hydraulic line	Manipulative- Install lines using recommended procedure. Explain procedure list, using an assigned unit various types of lines and define location of each type in the systems by indicating ie "Steel tubing-between ________ and ____________. Rubber lines-between ________ and ___________." etc.
C. Sample Components	C. View various types of fittings samples and identify	Select and identify four types of fittings used on assigned tractor-loader unit. Illustrate correct method of installing and tightening fittings.

OBJECTIVES BY UNIT

Unit 2 (cont) Identifying Component and Functions

Objective 2 (cont) Identify each major hydraulic component, and describe its functional operation

CONTENT

D. Filters and Screens
- Purpose of
- Types
  - full flow
  - in line filter B
- Components

E. Oil Coolers (heat exchangers)
- Purpose of
- Types
  - air cooled
  - water cooled
- Component parts

F. Pumps
- Purpose of
- Construction of
- Types of
  - positive or variable displacement
    - gear, vane or piston
  - variations
    - internal gear, external gear, lobe, gear-like vane, radial piston, axial piston, centrifical

G. Control Valves
- Purpose of
- Types of control valves
  - hand lever
  - cam
  - tang
  - pilot operated
  - foot operated
- Variables in valve spools
  - spring centered
  - spring offset
  - detented
- 4 way valve
- Poppet valve
- One way check valve
- Flow control valve
- Pressure reducing orifice

EDUCATION

Module AG HYDRAULIC SYSTEMS 01.0301-17

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
	A. Change an oil filter and clean screen	Change an oil filter
	B. View various types of pumps Identify each by name. Install pump on a machine	Identify types of pumps on hand out sheet, record type under each. Describe purpose of the hydraulic pump. Install a pump on a machine.
	C. View various types of control valves. Identify by name. Install a control valve on a machine.	Identify types of control valves on the tractor-loader unit assigned. Describe their operational function. Install a control valve on a machine.
	D. View sample relief valves. Identify by proper name.	Identify types of relief valves Record correct name on handout sheet. Draw a schematic of a typical hydraulic system. Locate in proper position . Main relief valve . Circuit relief valve

OBJECTIVES BY UNIT

Unit 2 (cont) Identifying Component and Functions

Objective 2 (cont) Identify each major hydraulic component, and describe its functional operation.

CONTENT

H. Relief Valves
- Purpose of
- Types
  - cartridge
  - ball and spring
  - poppet
  - pilot
  - circuit relief
  - main relief

  Variables
  - adjustable
  - nonadjustable

I. Cylinders
- Purpose of
- Classifications
  - single acting
  - double acting
  - double rod cylinder
  - telescoping
  - rotary
- Piston seals
  - purpose of
  - types of
    - automotive type
    - multiple vee
    - lip or cup
    - O'Ring w/ backup washer
    - O'Ring w/ plastic shoe
- Pod packing
  - purpose
  - types of
    - multiple vee
    - adjustable wrap around
    - O'Ring
- Operation principles

EDUCATION

Module AG HYDRAULIC SYSTEMS 01.0301-17

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
	A. View sample cylinders, identify by proper name. B. Remove and install a cylinder on a machine.	Identify various types of cylinders in the shop. Describe unit located on and where located on the machine. Identify types of cylinders on handout sheet recording name under each illustration.
	A. View sample packings, seals and identify. B. Remove and install seals, O'Ring, packing	Identify type of seals used shown on handout sheet. Record correct type below illustration. Install seals, packing and O'Rings

OBJECTIVES BY UNIT	CONTENT
Unit 2 (cont) Identifying Component and Functions Objective 2 (cont) Identify each major hydraulic component, and describe its functional operation.	J . Accumulation . Purpose . Types . Operational principles . bag type gas loaded . diaphragm gas loaded . spring loaded . weight loaded . non-separated
	K . Hydraulic Motors . Purpose of . Types of .vane . radial piston . axial piston . gear type . Operation of . Similarity to hydraulic pump
	L . Hose couplers . Purpose of . Types of . quick . breakaway . construction of

EDUCATION

Module AG HYDRAULIC SYSTEMS 01.0301-17

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
	A . View samples of accumulators B . Recharge and gas accumulator C . View handout sheet showing various types of accumulators	A. On handout sheet identify types of accumulators and record under each. B. Define purpose of an accumulator C. Recharge a gas accumulator Test accumulator Install on a machine
	A. View samples of hydraulic motors B. View handout sheet showing types of and hydraulic motors.	On handout sheet identify types of hydraulic motors and record under each.

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Pretesting Trouble-shooting Procedure	A. Review schematic of system concerned . Explain and identify each component and its proper operation characteristics
Objective 3 - Explain pretesting procedure and identify pertinent information necessary for troubleshooting.	B. List customer complaints C. Observe operation duplicating malfunction
	D. List characteristics
	E. Visual inspection of all components
Objective 4 - Recognize characteristics of operation which are causing malfunctions.	F. Test Equipment . Purpose of . Operation of equipment available . Other equipment not available in shop can be used if and when obtained
Objective 5 - Select proper test equipment to pinpoint malfunctions	G. Obtain pertinent specifications required for trouble-shooting from manufacturers shop manual . Gallons per minute output . Relief valve pressures - working pressures
	H. Safety precautions
	I. Terminologies

EDUCATION

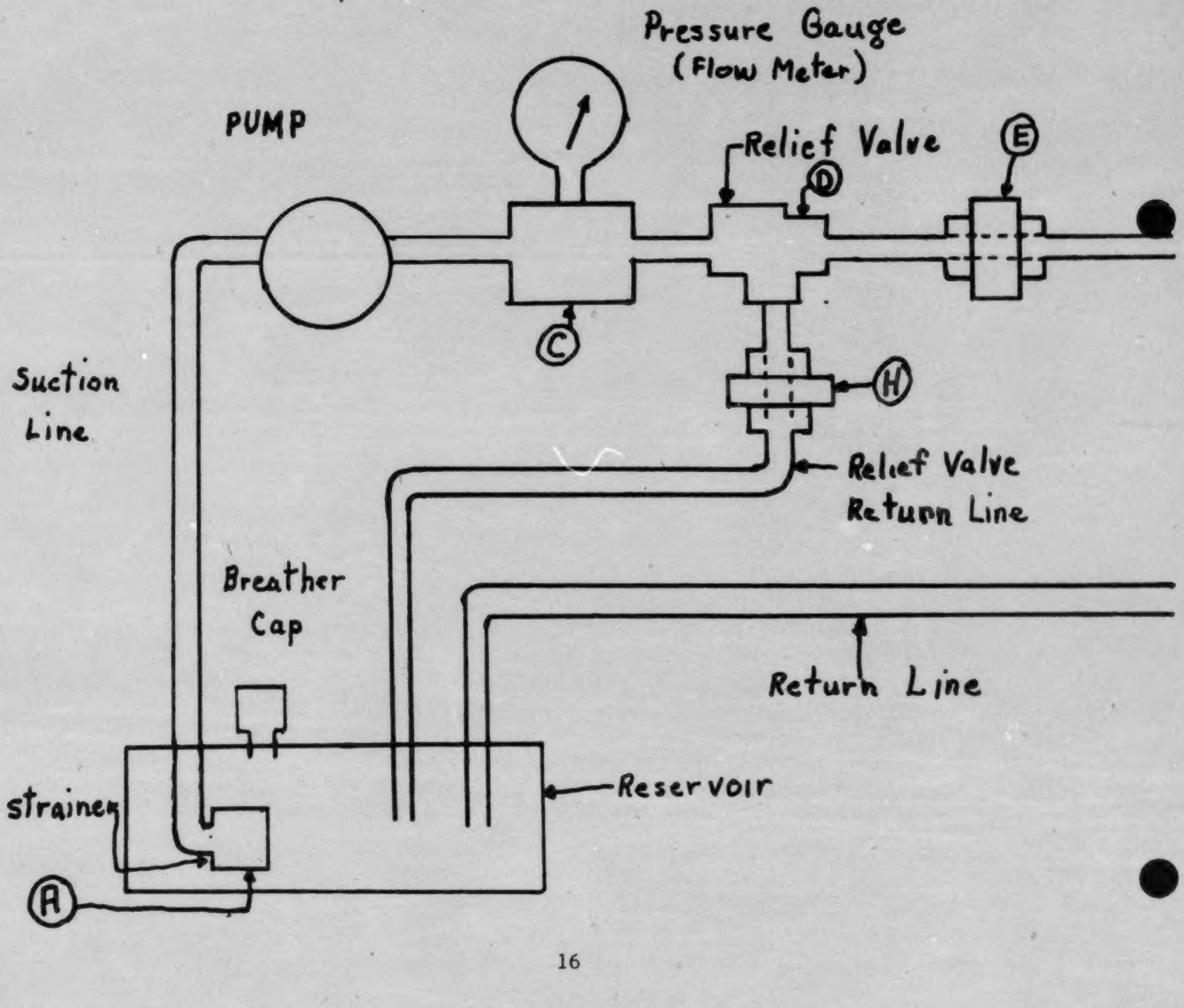
Module AG HYDRAULIC SYSTEMS 01.0301-17

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
Lecture and Demonstrating A . Correct Procedure . review schematic . customers description of explanation of malfunction . review manufacturers specifications . observe operation of system indicating undesirable characteristics . systematic troubleshooting procedure .. start at the system reservoir, to pump, to relief valve, etc. (use process of elimination by isolation of each individual component) from other portion of circuit. . explain operation of test equipment . flow rater-pressure gauge, etc. . safety procedure Demonstrate B . Operation and hookup of flow rater C . Operation of Pressure Gauge D . Systematic procedure Overhead Transparencies or slides showing E . Various additional hydraulic test equipment	A. Study schematic diagram on system concerned B. List customer description of malfunction on shop work order C. From shop manual obtain pertinent information on specifications record. D. List undesirable characteristics from observance of operation record on shop work order E. Perform actual systematic procedure F. Add terminologies to list	Written or Oral A. Explain the schematic diagram by identifying components and explain operational functions of each major component. B. Assign unit to student . List mfgr's specifications . List customer description and your observance of characteristics of malfunction . Recite definition of terminologies

AGRICULTURAL

Module AG HYDRAULIC SYSTEMS 01.0301-17

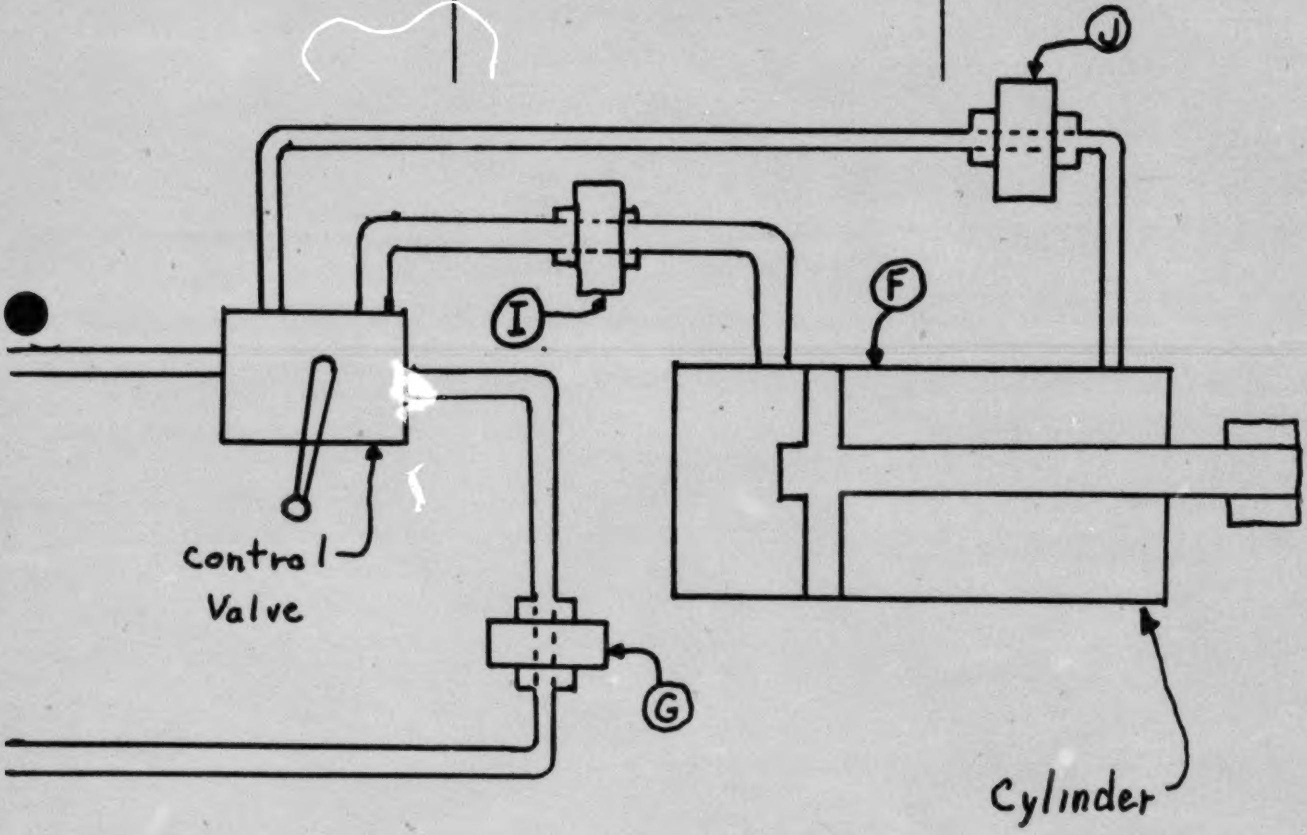
OBJECTIVES BY UNIT	CONTENT
Unit 3 - Testing Procedure Objective 6 - Perform a systematic troubleshooting procedure.	A. Systematic Procedure (start a Pump Suction Strainer)
Objective 7 - Efficiently use available hydraulic test equipment.	
Objective 8 - Efficiently check the pump suction strainer and identify cause of malfunction.	A. Check pump suction strainer at "A" . Clogged screen . Reinstallation - check all joints for air leaks . Oil level - (at least 2" above screen minimum)


Pressure Gauge
(Flow Meter)
PUMP
Relief Valve
E
D
C
H
Suction Line
Relief Valve Return Line
Breather Cap
Return Line
Strainer
Reservoir
A

EDUCATION

Module AG HYDRAULIC SYSTEMS 01.0301-17

TEACHING METHOD	**STUDENT APPLICATION ACTIVITY**	**EVALUATION PROCEDURES**
Lecture and Demonstration Correct procedure (USE attached diagram of system)	A. Perform troubleshooting procedure in systematic way on suction line. B. List of manufacturers specifications compare with test results C. Determine cause of contamination causing clogged strainer.	Explain systematic procedure and why this is best way.



AGRICULTURAL

Module AG HYDRAULIC SYSTEMS 01.0301-17

OBJECTIVES BY UNIT	CONTENT
Unit 4 - Testing Procedure Objective 9 - Efficiently isolate and perform tests on pump and main relief valve and identify causes of a malfunction	A. Install flow rater or pressure gauge at "C" between pump and main relief valve if cleaning strainer did not overcome problems. B. Isolate pump and main relief valve from complete circuit by installing a plug at "E" Note: all oil from pump must go thru relief valve and return to reservoir C. Observe flow and/or pressure on test gauges . If gauges meet specifications, pump and relief valve OK . If gauges do NOT meet specs, problem is in one of components, main relief or pump D. If #2 above further tests required . Disconnect "H" and attach hose. Run hose to reservoir filler opening . Observe flow or check GPM from pump. Also adjust relief valve from low setting to maximum specified setting . If flow is full hose or GPM is up to specifications under relief valve pressure. Pump OK. If not a full flow or GPM specs. Pump is malfunctioning - Replace pump. . If relief pressure per specifications can be reached - Relief valve OK. If pressure can not be obtained, repair or replace relief valve. E. If pump and relief valve OK, problem is further down stream in the circuit.

Module AG HYDRAULIC SYSTEMS 01.0301-17

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
Demonstrate Operation and hookup of flow rater installing in line Systematic procedure	A. Perform pump and main relief valve test B. Add to terminology list C. Determine cause of failure	A. Assign unit to student . List specifications for manual . Perform test procedure . Locate malfunction component . Use test equipment . Repair component per mfgr. shop flat rate time

OBJECTIVES BY UNIT	CONTENT
Unit 4 - Testing Procedure Objective 10 - Isolate and perform leakage tests on hydraulic cylinders and identify causes of malfunction	F. Cylinder leakage test-Piston packing or piston seals. Disconnect line at "J" apply specifications relief valve pressure on piston end of cylinder. If oil is forced out or leaks out of disconnected line at "J", oil is bypassing the piston from the piston end of the cylinder. Reverse Procedure Reconnect line at "J" and disconnect line at "I". Apply specified relief pressure on rod end of cylinder. If oil leaks out or is forced out at "I", oil is by-passing piston from the rod end of the cylinder. Repair or replace piston seals. Recommend line at "I". G. Follow same procedure on other cylinders in the system.
Objective 11 - Efficiently isolate and perform leakage test on hydraulic control valve and to identify causes of malfunctions.	H. Apply relief valve pressure on a rod end of a specific cylinder by actuating a control valve, Disconnect line beyond the control valve at "g". If oil leaks or pressure reduces out of rod end of cylinder, the control spool for that circuit is damaged or worn or a seal on the valve spool is leaking. REVERSE PROCEDURE FOR piston end of control valve

EDUCATION

Module AG HYDRAULIC SYSTEMS 01.0301-17

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
Demonstrate and discuss . Procedure for cylinder leakage test . Terminologies	A. Test a cylinder for leakage past piston B. Hook up correct test equipment C. Add to terminology list D. Determine cause of failure	A. Perform test and analyze results. B. Repair cylinder per mfgr's. specifications and procedure. C. Terminologies
Demonstrate and Discuss . Leakage test on control valve . Terminologies	Perform leakage test on each control valve in the system. Hook up correct test equipment Check control valve spool diameter per mfgr's specification w/ micrometer Add to terminology list Determine cause of failure	Perform test and analyze results Perform repair on control valve per mfgr's recommended procedure and specifications Terminologies

AGRICULTURAL

Module AG HYDRAULIC SYSTEMS 01,0301-17

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Repairing Components	NOTE: Specific information concerning disassemble and reassemble procedure, and specifications should be obtained from the Manufacturers Shop Manual Generalization of Service Procedure A . Installing and removal seals procedure B . Installing and removal O'Rings procedure C . Checking removing and reinstalling relief valve seats

EDUCATION

Module AG HYDRAULIC SYSTEMS 01.0301-17

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
Individual Instruction	A. Obtain repairing procedures from mfgrs. manual	A. Assign components for repair . Obtain mfgrs.procedures . Outline procedure . List malfunction characteristics
General discussion by components concerning disassembly and reassembly-generalization	B. Disassemble and reassemble components	
Safety Precautions	C. Inspect components	
	D. Measure components	B. Test oral or written on hydraulic terminologies
	E. Add to terminology list	C. Test oral or written on hydraulic safety precautions

MODULE OF INSTRUCTION

Title - AG HYDRAULIC SYSTEMS Code - 01.0301-17

RESOURCE MATERIALS

Books:

Mobile Hydraulics Manual. M. 2990.S Sperry Rand Corporation. Troy, Michigan. 48084
Tractors and Crawlers. Eshelman. American Technical Society. Chicago.
Fundamentals of Service - hydraulics. by John Deere Co. Moline, Ill.
Operation and Care of Hydraulic Machinery. Texaco, Inc. 135 East 42nd St., New York, N. Y. 10017
Mobile Hydraulic Testing. R. E. Glenn. J. E. Blinn. American Technical Society.
Massey Ferguson Inc. capsule #6 - Hydraulic Theory and Application Form #ST-1002 4/68 B & L

Audiovisuals:

Fundamentals of Service - Hydraulics Visuals. John Deere Co., Moline, Ill.
Master Set of Slides on Hydraulics. International Harvester Co. Implement Dept. 180 N. Michigan Ave., Chicago, Ill.

MODULE OF INSTRUCTION

Title - TILLAGE EQUIPMENT

Code - 01.0301-18

DESCRIPTION:

This module will enable the student to understand the operation, service, adjustment and repair of common tillage equipment. Students will perform skills in the shop and in the field using operating and service manuals and suitable shop tools or equipment.

He will learn to correctly hitch the equipment to the tractor and to properly adjust the hitch. Included will be practice on various types of moldboard and disc plows, harrows, field cultivators, rollers and other specialized tillage equipment.

MAJOR DIVISIONS OR UNITS OF CONTENT

	Time Allocations	
	Class	Other
1. Types of Tillage Equipment	1	1
2. Parts Identification	1	2
3. Types of Hitches and Hitching	1	2
4. Use of Operators and Service Manuals	1	1
5. Adjusting Tillage Equipment	1	12
6. Trouble-Shooting and Storage	1	6
	6	24

Revised June 1975

MODULE OF INSTRUCTION

Title - TILLAGE EQUIPMENT Code - 01.0301-18

Objectives to be obtained:

The student will be able to:

1. Identify the types of tillage equipment that he will come in contact with in the field or a dealers' inventory, to the satisfaction of the instructor.

2. Correctly identify the important parts of tillage equipment and the function of each part to the satisfaction of the instructor.

3. Properly adjust the hitch and hitch the piece of equipment properly so that it will operate according to the manufacturers' specifications.

4. Develop an ability to read and use the operators' and service manuals provided with the equipment when operating, servicing and/or adjusting the equipment in the shop or the field.

5. Under shop and field conditions, make the necessary adjustments to the equipment which will make it perform properly according to the manufacturers' specifications and the satisfaction of the instructor.

6. Trouble-shoot a malfunctioning machine in the shop or the field, diagnose and correct the trouble.

7. Perform the jobs necessary to store the equipment for the off-season with materials and equipment provided in the shop.

Code - 01.0301-18

Title - TILLAGE EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Types of Tillage Equipment Objective 1 Identify the types of tillage equipment that he will come in contact with in the field or a dealers' inventory, to the satisfaction of the instructor.	A. Primary tillage equipment . Moldboard plows . trailing . semi-mounted . integral-mounted . Disc plows . trailing . semi-mounted . integral-mounted . Rotary . pull auxiliary engine . pull PTO driven . self-propelled . Chisel and subsurface B. Secondary tillage equipment . Harrows . disc . spike-tooth . spring-tooth . Land rollers and pulverizers . Field cultivators . Rotary hoes

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion - review text Farm Machinery and Equipment; also manual "Plows and Plowing," Ohio State University. B. Prepare a field trip to local farms and/or dealership to become familiar with the various types of plows. C. Set-up a schedule of pickup of students' home farm equipment for use in the shop or lab.	A. Review information in text provided by instructor - Farm Machinery and Equipment. B. Identify various equipment found on local farms or dealerships' lot. C. Provide a piece of equipment for use in the school shop or lab.	A. Students identify the various types of tillage equipment in a dealership lot either orally or on a sheet of paper.
A. Class discussion - review text Farm Machinery and Equipment; also manual "Plows and Plowing, " Ohio State University. B Prepare a field trip to local farms and/or dealership to become familiar with the various types of plows. C. Set-up a schedule of pickup of students' home farm equipment for use in the shop or lab.	A. Review information in text provided by instructor - Farm Machinery and Equipment. B. Identify various equipment found on local farms or dealerships' lot. C. Provide a piece of equipment for use in the school shop or lab.	A. Students identify the various types of tillage equipment in a dealership lot either orally or on a sheet of paper.

Code - 01.0301-18

Title - TILLAGE EQUIPMENT

<table>
<tr><th>OBJECTIVES BY UNIT</th><th>CONTENT</th></tr>
<tr>
<td>Unit 2 - Parts Identification
Objective 2
Correctly identify the important parts of tillage equipment and the function of each part to the satisfaction of the instructor.</td>
<td>A. Primary tillage equipment
Example: Moldboard plow
<table>
<tr><th>Part</th><th>Function</th></tr>
<tr><td>Beam</td><td>The frame that holds the plow bottoms in the correct position.</td></tr>
<tr><td>Frog</td><td>That part of the plow to which all other bottom parts are bolted.</td></tr>
<tr><td>Share</td><td>That part of the plow bottom that cuts the underside of the furrow slice away from the land.</td></tr>
<tr><td>Moldboard</td><td>Turns the furrow slice on edge.</td></tr>
<tr><td>Landslide</td><td>The long flat metal piece which absorbs the side forces created when the furrow is turned and levels the plow bottom into a free floating position.</td></tr>
</table>
Etc.</td>
</tr>
</table>

01.0301-18 - Code

TILLAGE EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Use overhead projector and transparencies, parts manuals, etc. to show the various parts of equipment to students. B. Using disassembled machine give proper identification of parts to students. C. Have students identify parts of their assigned machines.	A. Identify parts of machines assigned following review of information provided by instructor. B. Learn the function of each part of the equipment being studied.	A. Use ditto sheets with pictures or diagrams of machine parts for students to fill in name of parts of machines. B. Ask the student to describe the function of the parts orally (picked at random).

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Types of Hitches and Hitching. Objective 3 Properly adjust the hitch and hitch the piece of equipment properly so that it will operate according to the manufacturers' specifications.	A. Moldboard plow hitches . Trailing plow . vertical line of draft . horizontal line of draft . center of load . side draft . Semi-mounted plows . Integral-mounted plows . Disc plows . Tandem and multiple unit hitches . Spring release hitches

EDUCATION

Module TILLAGE EQUIPMENT 01.0301.18

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Review text Machines for Power Farming, Pages 154 to 167 also Plows and Plowing, Manual page 32 to 36 and 59 to 102.	A. Using information provided by the instructor and found in the references determine the draft lines and correct maladjustments.	A. Have students locate the various lines of draft involved on their assigned piece of equipment in an oral report.
B. Prepare ditto sheets for use by students from illustrations given in Plows and Plowing Manual.	B. Use owner/operator manual and attach or hitch implements as per instructions.	B. Student should attach their assigned item of equipment to a tractor safely and according to the manufacturers' specifications.
C. Demonstrate the determination of the draft points on the equipment brought into the shop for this module.		
D. Demonstrate using the operators manual provided the proper method of hitching the various types of equipment.		

OBJECTIVES BY UNIT	**CONTENT**
Unit 4 - Use of operators' and service manuals. Objective 4 Develop an ability to read and use the operators' and service manuals provided with the equipment when operating, servicing and/or adjusting the equipment in the shop or the field.	A. Operators' manual information . Machine specifications . Lubrication . Operation . Adjustments . Trouble-shooting . Attachments . Setting up instructions B. Dealers Service Manual . Disassembly . Inspection . Repair . Reassembly procedure

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Demonstrate the use of the operators' and service manuals in making adjustments and repairs on the equipment in shop. B. Have a lubrication specialist from a major line oil company speak on and demonstrate use of oils and greases for farm equipment.	A. Use the operators' manual for assigned machine and lubricate, adjust and/or repair the machine. B. Select and use the recommended lubricants and lubricating equipment for lubrication of machine assigned.	A. Check students' ability to use the operators' manual to locate specific information on an adjustment and then make the adjustment according to recommendations given.

Code - 01.0301-18

A G R I C U L T U R A L

Title - TILLAGE EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Adjusting Tillage Equipment Objective 5 Under shop and field conditions, make the necessary adjustments to the equipment which will make it perform properly according to the manufacturers' specifications and the satisfaction of the instructor.	A. Plows . Depth control adjustments . trailer plows . semi-mounted . integral-mounted . Width of cut-adjustment . Leveling - adjustment . Hitch . Coulters and other trash covering devices . Gauge wheels B. Disc - adjustments for: . Single action . Double action . Off-set C. Harrows

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Refer to manual - Plows and Plowing, Ohio State University, Pages 103-124.	A. Follow information provided by instructor and that found in the operators' manual to make adjustments to the specifications set by the manufacturer.	A. Check adjustments made by student to determine his ability to follow printed instructions as recommended by the manufacturer.
B. Make ditto sheets and overhead transparencies of the forms on pages 116 and also page 120 for use in this exercise.	B. Use the ditto sheets provided as a guide to perform the adjustments needed on the machine assigned.	B. Check operation of machine following adjustment as to its proper function in accordance with specifications.
C. Demonstrate the method of adjustment recommended in the Owner's Manual using machines in the shop.		

OBJECTIVES BY UNIT	CONTENT
Unit 6 - Trouble-Shooting and Storage. Objective 6 Trouble-shoot a malfunctioning machine in the shop or the field, diagnose and correct the trouble.	A. Diagnosing guide . Know the system . understand how the machine is designed to work. . Ask the owner/operator . discuss malfunctions with the person using the machine . Inspect the machine . Look the machine over to locate the possible cause of trouble . Operate the machine . run the machine in the shop or field to check for the difficulty . List the possible causes . make a list of the causes from the chart in the Owner's Manual . Reach a conclusion . decide on the probable cause . Test your conclusion . make the adjustment and then check out operation

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Discuss the use of the diagnosing guide for trouble-shooting of any equipment problem or mal-function.	A. Make use of the diagnosing guide discussed and provided by the instructor to trouble-shoot a problem with the assigned machine.	A. Check the students' ability to follow the trouble-shooting procedure and correct the mal-function found in his assigned machine.
B. Prepare ditto sheet outlines of the diagnosing guide for students use.	B. Locate the problem in another machine other than the one assigned and correct the malfunction.	B. Have the student check out a problem found in another machine and correct it to the manufacturers' specifications.
C. Demonstrate the actual trouble-shooting procedure using the guide on a machine in the shop.		
D. Point out the section of the Owner/Operators' Manual on the trouble-shooting or field problem recommendations.		

OBJECTIVES BY UNIT	**CONTENT**
	A. Preparation for storage

Objective 7
Perform the jobs necessary to store the equipment for the off-season with materials and equipment provided in the shop to his and the instructors satisfaction.
	. Clean the machine or equipment.
	. Inspect the equipment for broken or worn parts.
	. Order replacement parts.
	. Lubricate the machine
	  . check gear cases, etc.
	  . pressure lubricate all fittings
	. Examine exposed metal surfaces
	  . place guards over any sharp edges.
	. Block up machine
	  . remove weight from tires and wheels.
	. Paint bare or exposed surfaces or coat with a protective material.

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Discuss the storage procedures for the various equipment assigned to students.	A. Prepare the assigned machine for storage following the procedure outlined by the instructor.	A. Check the machine prepared by the student for storage and mark progress chart for completion.
B. Demonstrate the proper protection of/or for both inside and outside storage.		

MODULE OF INSTRUCTION

Title - TILLAGE EQUIPMENT

Code - 01.0301-18

RESOURCE MATERIALS

Books -
1. Teacher references
   - a) Principles of Farm Machinery, Bainer, Kepner, Barger - J. Wiley & Sons
   - b) Farm Machinery and Equipment, Smith, McGraw-Hill Co.
   - c) Engineering Bulletin FT-53A, American Oil Company
   - d) Mechanics in Agriculture, Lloyd J. Phipps, the Interstate.
2. Student references
   - a) Machines for Power Farming, Stove and Gulvin, J. Wiley & Sons
   - b) Farm Shop Skills, Sampson, Mowery, Kugler, American Tech, Soc.
   - c) The Operation, Care and Repair of Farm Machinery, John Deere Co.

Bulletins -
1. Teacher references
   - a) E1176 Tillage: Basic Principles and Techniques, Wilson & Winkelbleck, Cornell University.
   - b) Agdex 741 Plows and Plowing, Staff, Ohio State University
2. Student references
   - a) Machine Owner/Operator Manuals, Manufacturers'.
   - b) 4-H Tractor Program Manual 1-4.

Periodicals -
1. Teacher references
   - a) Farm Power and Equipment, National Farm Power & Equipment Dealers Association
   - b) Implement and Tractor, Technical Publications Inc.
2. Student references
   - a) American Agriculturalist, Ithaca, New York
   - b) Hoard's Dairymen,

Audiovisuals -

Various - Obtainable from manufacturers service departments and/or local equipment dealers.

Example: Hitching and Adjusting Tractor-Drawn Moldboard Plows,
John Deere Company - Film Library, 2212 No. Broadway
St. Louis, Missouri 63166

MODULE OF INSTRUCTION

Title - PLANTING, SPRAYING AND FERTILIZING EQUIPMENT Code - 01.0301-19

DESCRIPTION:

This module is designed to provide the student with the understanding, skill and ability to select, operate, adjust and maintain equipment which is used to plant seed, apply chemicals, and distribute fertilizers. Servicing and repairing of manure spreaders is also included.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Other
1. Crop Planting Equipment	2	8
2. Spraying and Dusting Equipment	2	6
3. Fertilizing Equipment	3	9
	7	23

Revised January, 1975

MODULE OF INSTRUCTION

Title - PLANTING, SPRAYING AND FERTILIZING EQUIPMENT Code - 01.0301-19

Objectives to be obtained:

The student will be able to:

1. Identify the types and discuss the functions of the parts of crop planters in the field or a dealer's inventory.

2. Properly adjust the planters in the shop or field so that they will operate according to manufacturer's specifications.

3. Use the owner/operator's manual and select the proper plates and/or planting rate adjustments for a particular crop seed to be planted.

4. Recondition planting equipment in the shop following a recommended procedure that will make for a more efficient and longer lasting machine.

5. Recognize and identify the various spraying and dusting equipment found in the field or a dealer's inventory.

6. Check over a sprayer and perform a calibration to determine its efficiency or application rate.

7. Recommend type of manure spreader and explain the proper servicing procedures suggested in the owner/operator's manual for the machine.

8. Use the tools and equipment available in the shop to locate and correct the problem in a mal-functioning spreader to the satisfaction of the instructor.

9. Perform the suggested steps of a reconditioning procedure on a used manure spreader in the shop that meets standards set by industry.

10. Demonstrate an understanding of the purpose and the operation of fertilizer distributing equipment used on farms of today.

11. Complete the various maintenances required on a fertilizer distributor which must be performed daily and/or seasonally to the instructor's satisfaction.

12. Demonstrate a knowledge of the types, uses and services required for other fertilizing equipment available to agriculture.

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Crop Planting Equipment Objective 1 Identify the types and discuss the functions of the parts of crop planters that he will come in contact with in the field or a dealer's inventory	A. Row crop planters . Types . regular drill planters . check row planters . trailer type . mounted type . hill drop . trailer type . mounted type
Objective 2 Properly adjust the planters in the shop or field so that they will operate according to manufacturers specification.	. Major corn planter parts . hopper duplex hoppers are used for most all seed . tip over type boxes . seed plate . filler plate Seed Plates . edge drop . flat drop . hill drop . furrow openers . furrow covers . dress wheel type . disc cover type . driving devices . wheels and axles . markers . hitches . power lifts

DUCATION

Module PLANTING, SPRAYING AND FERTILIZING EQUIPMENT 01.0301-19

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Review reference *Farm Power and Machinery Management* - Donnell Hunt, Iowa State University	A. Study information in references assigned	A. Use ditto sheets of parts to corn planters and have students write in the names of the parts illustrated
B. Discuss information found in the reference, *Farm Machinery and Equipment* H.P. Smith, with students	B. Set the planter brought in for study and service up on blocks check to see that it is level and later hitch it to a tractor	B. Have students demonstrate the alignment of chains and sprockets on a corn planter
C. Demonstrate how to: • Clean and check operation of planter parts • Change press wheel pressure • Select proper seed plates • Adjust for desired planting depth • Change row spacing • Adjust chain tension • Clean and service fertilizer attachment • Adjust furrow openers	C. Check and/or make the following adjustments • Row spacing • Sprocket and chain alignment also chain tension • Furrow openers	C. Have students select the seed plate number from the owner's manual for a specific variety of corn to be planted.
D. Show film strip, *Successful Calibration of Corn Planters* Extension Office, University of Illinois	D. Operate the planter by hand while blocked up to check for any misalignments and/or improper adjustment	
E. Demonstrate the calibration of the corn planter.	E. Insert the planter plates and calibrate the planter	

OBJECTIVES BY UNIT	CONTENT
Objective 3 Use the owner/operator's manual and select the proper plates and/or planting rate adjustments for a particular crop seed to be planted	. Fertilizer attachments . types . principle of operation . Operating a planter . select correct plates . make desired depth adjustment . check the marker operation . check driving devices for freedom of operation . Lubricate all movable parts B. Broadcast . Types of grain drills . plain . trailer . mounted . fertilizer drill . trailer . mounted . Drill sizes Size of drills may be expressed in: . width in feet . number of furrow openers . spacing between runs . Major drill parts . feeding devices . frames . furrow openers . wheels . drag bars . axles . seed covers . hoppers
Objective 4 Recondition planting equipment in the shop following a recommended procedure that will make for a more efficient and longer lasting machine	. Fertilizer devices for grain drills . Grass seed attachments . Operating, adjusting and servicing the grain drill . adjusting for rate of seeding . calibrating a drill . setting the fertilizer feed . setting the grass seed attachment . adjusting the hitch . lubricating the drill bearings

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
F. Discuss the causes of: • Inaccurate drop • Scattering of seed in the row • Furrow openers not penetrating ground • Feed or fertilizer not covered • Soil not compacted around seed • Planter missing sets of hills • Plates cracking the seed	F. Follow the steps outlined in class on a used planter in need of reconditioning if assigned. • Identified by make, model etc. using the owner's manual • Cleaned thoroughly • Checked for needed replacement parts • Install new parts • Lubricated properly • Calibrated before using	D. Observe the students progress during the reconditioning of a used corn planter if so assigned
A. Refer to reference indicated above and discuss with students information about grain drills	A. Study reference assignment given by instructor	E. Have student explain his correction for some particular malfunction identified by the instructor
B. Review and discuss information found in the operator's manual with the grain drill being covered.	B. Obtain a grain drill for shop work if possible or available from home farm	
C. Demonstrate how to: . Systematically check for worn or damaged parts . Regulate drill to get desired seeding rate with different kinds of seed	C. Use owner/operator's manual and follow same procedure outlined for work on the corn planter assigned	
D. Refer again to the film strip on calibration indicated above	D. Reconditioning procedure should be followed if a drill needing such service is brought in for this assignment	
E. Show or demonstrate . Hitch adjustment . Adjustment of furrow opener scraper . Checking the seed tubes, furrow openers and covering devices . Cleaning or protecting fertilizer attachment . Adjusting for proper seeding depth . Proper lubrication	E. Discuss the various causes of inefficient or improper operation as indicated for corn planters.	

OBJECTIVES BY UNIT	CONTENT
Unit 2-Spraying and Dusting Equipment Objective 5 Recognize and identify the various spraying and dusting equipment found in the field or dealer's inventory	A. Sprayers and dusters . Types . liquid or hydraulic sprayers . gas and liquid (usually water) . row type . tree sprayers . air (dusters) . engine operated . traction . airplane dusters . Pumps . reciprocating . rotary . roller impeller . pneumatic . side vane rotary . centrifrigal . diaphragm
Objective 6 Check over a sprayer and perform a calibration to determine its efficiency or application rate prior to putting it into the field	. Nozzles . liquid . fan type . hollow cone . solid cone . air . mist . dust . Booms . orchard . vineyard . open field . row crop . Strainers . Regulators . Tanks . Fans

EDUCATION

odule PLANTING, SPRAYING AND FERTILIZING EQUIPMENT 01.0301-19

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Refer to references already referred to: chapter 26, Machines for Power Farming, pages 359-383 also chapter 14, Farm Machinery and Equipment pages 237 to 267	A. Review the references assigned for study of spraying and dusting equipment	A. Have students identify illustrations of parts to sprayers or dusters by writing in the name on the ditto sheet
B. Explain the operation of a reciprocating spray pump, external gear rotary pump	B. Secure a sprayer or duster for shop assignment on this type of equipment if available from home farm	B. Observe progress of student during the assembly of a new sprayer if given this particular shop assignment
C. Discuss the purposes of sprayer mozzles, booms, strainers.	C. If a new sprayer is purchased for the home farm bring it to the school shop for: • Assembly following the manual provided for this purpose • Make necessary adjustments • Lubricate thoroughly	C. Check students ability to properly calibrate a sprayer in the shop or yard adjacent to the shop
D. Demonstrate such specific things on a sprayer or duster as: • Major parts of the pump • Operating principles of the sprayers • Location of strainers • Operating principles • of the sprayers • Hydraulic • Motor driven • How to calibrate a sprayer	D. Used sprayer or duster may be brought in to the school shop from the home farm and the following performed: • Clean thoroughly • Check for parts that need repairing, replacing and order these parts • Recondition or replace parts obtained • Clean sprayer lines, etc. check agitator assembly • Calibrate reconditioned sprayer	

Module PLANTING, SPRAYING AND FERTILIZING EQUIPMENT 01.0301-19

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Fertilizing Equipment Objective 7 Recommend a type of manure spreader and explain the proper servicing procedures suggested in the owner/operator's manual for the machine	A. Manure spreaders . Types . ground driver . P.T.O. . Sizes . box capacity . other . Nomenclature . frame . type of construction . box . type of construction . capacity (how figured) . conveyor mechanism . types . how they work . beaters and beater drives . gears
Objective 8 Use the tools and equipment available in the shop, locate and correct the problem in a malfunction of a spreader to the satisfaction of the instructor	. chain and sprockets . widespread devices . types . purpose . Spreader variations . tanks . top opening . side opening

Module PLANTING, SPRAYING AND FERTILIZING EQUIPMENT 01.0301-19

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Refer to texts previously indicated and review operators and service manuals for specific make, model, etc. of the machines available	A. Review references assigned by the instructor and become acquainted with information included	A. Give a student information about a particular farm and have him recommend a specific manure spreader explaining reasons for his selection.
B. Prepare transparencies from manufactures'parts catalogs for explaining parts identification and/or nomenclature	B. Learn the names of the various parts of the machine from the hitch to the widespread	B. Have the student role play a dealer serviceman explaining the servicing procedures outlined in the owner's manual
C. Discuss the advantages and disadvantages of the various types of spreaders	C. Check the manure spreaders brought into the shop for all the required safety shields etc.	C. Assign a manure spreader to a student, which has a retention dog spring removed and have him locate and correct this problem
D. Describe the methods and importance of proper loading of a spreader for more efficient operation	D. Assist with assembly of a new manure spreader if this job is assigned	
E. Stress the necessity of safety skills, clutches, etc. especially during the operation of a spreader	E. Demonstrate ability to load a spreader and set the levers for the suggested rate of application	
F. Obtain a new unassembled spreader (there are still some makes that are not pre-assembled at the factory) or spreaders for the class to set up in the shop	F. Perform the steps outlined by the instructor for the checking of a machine for more efficient operation and continued use	
G. Arrange a field trip to a students home farm where the various types of spreaders may be operated, loaded and checked over by the class		

OBJECTIVES BY UNIT	CONTENT

Objective 9
Perform the suggested steps of a reconditioning procedure on a used manure spreader in the shop that meets standards set by industry
	. Operating, adjusting, and servicing manure spreaders
	  . attaching, loading and spreading are important operating functions
	  . adjustments to be made
	    . conveyor
	    . drives
	    . feed control
	  . lubrication
	    . use owner's manual
	  . maintenance
	    . chain tightness
	    . tighten loose bolts and nuts
	    . keep machine clean
	    . keep safety shields in place

Objective 10
Demonstrate an understanding of the purpose and the operation of fertilizer distributing equipment used on farms of today
	B. Granular distributors
	  . Purpose
	    . uniform distribution
	    . other uses
	  . Types
	    . ground driven
	    . mounted P.T. D.
	    . airplane - fan
	  . Sizes and specifications
	    . width of hopper
	    . capacity
	    . weight
	  . Agitators and/or rotors
	  . Shutters

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
H. Demonstrate such things as: · Checking for loose bolts and nuts · Checking for defective links, kinks, and/or binding · Cleaning bale twine and other such refuse from the spreader · Lubricating according to the chart in the owner/operator's manual	G. Follow procedure outlined for reconditioning if assigned spreader has been brought in for that purpose	D. Check progress of student performing the reconditioning work on a manure spreader brought in for that purpose
I. Outline a procedure for the reconditioning of the spread which should be done at least every two years · Thoroughly clean the spreader · Remove all chains and repair and lubricate · Replace all broken or work sprockets · Straighten beater bars and paddles · Tighten all bolts, nuts etc. · Lubricate spreader completely · Paint or coat box inside and outside		
A. Review the reference material assigned students and also those other available to the instructor	A. Study references assigned by the instructor on fertilizer distributors	A. Ask the students to describe the various purposes of fertilizing equipment used on their home or neighboring farms
B. Describe and point out the various parts to the fertilizer distributors brought in to the shop for repair.	B. Secure a granular fertilizer distributor for shop work from the home farm if available	
C. Explain the use of the owner/operator's manual for setting the distributor for a particular fertilizer to apply the material at a certain rate at a given speed of travel.	C. If a new distributor is being considered and purchased for the home farm, buy it unassembled and bring it to the school shop for assembly	
D. Stress certain safety factors involved with various kinds of fertilizer chemicals, operation in the field without riders, etc.		

OBJECTIVES BY UNIT	CONTENT

Objective 11
Complete the various maintenance required on a fertilizer distributor which must be performed daily and/or seasonally to the instructors satisfaction
	. Levers
	. Hoppers
	    . construction
	    . materials
	. Frame and draw bar
	. Clutches, wheels and axles
	. Operating, adjusting and servicing granular distributors
	    . attaching the distributor to a tractor or other power source
	    . setting the rate of distribution for specific fertilizer
	    . cleaning after use has a bearing on the future use of the distributor
	    . lubrication

Objective 12
Demonstrate a knowledge of the uses and services required for other fertilizing equipment available to agriculture
	C. Gas and Liquid distributors
	. Type
	    . high, low and non-pressure
	. Tanks
	    . transporting
	    . storage (field)
	    . distribution
	        . tractor mounted
	        . trailer
	. Metering devices
	    . regulators
	    . shut off
	. Applicators
	    . types
	        . foot
	        . shank
	        . knife
	. Calibration
	    . charts in manual
	        . speed
	        . distance
	. Operating adjusting and servicing the gas-liquid fertilizer distributor
	    . storage tanks maintenance
	    . hitching, maintaining, on the tractor for field operation
	    . regulation by metering devices according to charts furnished in manual
	    . cleaning and flushing after use is very important

Module PLANTING, SPRAYING AND FERTILIZING EQUIPMENT 01.0301-19

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
E. Discuss the recommended placement or location of the granular fertilizer in relation to the seed being planted	D. A used fertilizer distributor from the home farm may be brought in and the following performed: • Clean thoroughly • Check for parts that need repairing, replacing and order the parts • Recondition or replace parts • Check chains, sprockets and gears for necessary adjustments • Lubricate all fittings • Touch up rusted or bare spots with paint	F. Assign a machine used for fertilizing to a student requiring daily or seasonal maintenance and observe or check his ability to do the job properly.
F. Arrange a field trip to a farm, possibly a students home farm for the purpose of operating this type of equipment under field conditions.		
G. Demonstrate the recommended method of setting or adjusting the machine for the kind of fertilizer to be applied		
H. List the steps again that are recommended for cleaning and protecting equipment for future use and operating efficiency		
A. Review reference information with students as previously indicated	(Follow outline as previously for granular distributors)	G. Have student explain the operation of some very new and different type of equipment observed during a field trip to acquaint them with the equipment
B. List and stress the precautions to be taken with the equipment and especially with the handling of the chemicals involved with this type of equipment		H. Ask students to point out variations between the common and the uncommon fertilizing equipment
C. It will be necessary to contact a chemical company to arrange a field trip to a storage facility or depot to observe the handling of these materials and the explanation of operation of the equipment		
D. Demonstration of the calibration of this kind of equipment should be handled by individuals supplying and distributing the material.		
E. Reference should be made to the use of the manufacturer's manuals with equipment for the proper operation, adjustment and servicing of this equipment.		

MODULE OF INSTRUCTION

Title - PLANTING, SPRAYING AND FERTILIZING EQUIPMENT Code - 01.0301-19

RESOURCE MATERIALS

BOOKS -

1. Teacher reference

   a) Farm Power and Machinery Management
   Donnell Hunt, Ames, Iowa 1964
   b) Planters - Complete Unit Overhaul (GSS-1354)
   International Harvester, Co., Chicago, Illinois

2. Student reference
   a) Farm Machinery and Equipment, H.P. Smith
   McGraw-Hill Book Co., New York, N.Y. 1964
   b) Machines for Power Farming, Stone and Guloin,
   John Wiley and Sons, Inc. New York, New York 1967

BULLETINS -

1. #C837 Calibrating and Maintaining Spray Equipment 1961 Department of Agriculture Education, Columbus, Ohio 43210

2. #AE 68 Narrow Row Equipment for Corn and Soybeans 1967, Purdue University LaFayette, Indiana 47907

PERIODICALS -

1. Teacher reference
   a) Farm Power and Equipment, National Farm Power and Equipment Dealer's Association, 2340 Hampton Ave, St. Louis, Mo. 63139

   b) Implement and Tractor Technical Publications, Intertec Publishing Corp. 1014 Wyndotte St, Kansas City, Mo. 64105

2. Student references

   a) Farm Journal, 230 W. Washington Square, Philadelphia, Penn 19105
   b) Successful Farming, Meredith Corp 1716 Locust St., DesMoines, Iowa 50303
   c) American Agriculturist, Savings Bank Bldg., Ithaca, New York 14850
   d) Hoard's Dairymen, DesMoines, Iowa 50303

AUDIOVISUALS -

1. Reconditioning a Grain Drill, 30 min. film B&W, Purdue University, LaFayette, Ind. 47907
2. Successful Calibration of Corn Planters, filmstrip, Extension Service, University of Illinois, Urbana, Illinois 61801

MODULE OF INSTRUCTION

Title - HAY AND FORAGE EQUIPMENT Code - 01.0301-20

DESCRIPTION:

This module will include maintenance, operation, repair, and adjustment of common hay and forage equipment. Mowers, hay conditioners, rakes, balers, forage harvesters, and forage wagons are some of the equipment to be covered.

It is deemed most wise to use the operator's and manufacturer's service manuals as the basic repair and adjustment references.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Mowers	1	5
2. Conditioners	1	4
3. Rakes	½	2
4. Balers	1½	5
5. Forage Harvesters	1	5
6. Forage Blowers	½	1
7. Forage Wagons	½	2
	6	24

Revised June, 1974

MODULE OF INSTRUCTION

Title - HAY AND FORAGE EQUIPMENT

Code - 01.0301-20

OBJECTIVES to be obtained:

The student will be able to:

1. Identify the machine by make, model and serial number using the owner/operators manual and record this information legibly.
2. Orally explain the function of machine parts or components during class discussion.
3. Properly hitch machine to power source demonstrating observance of correct safety practices.
4. Select and use the recommended lubricants, perform the necessary service procedures for the machine.
5. Describe the various types of each machine used by farms in the area and indicate advantages and/or disadvantages of the different machines.
6. Demonstrate ability to operate a machine and locate a malfunction needing correction.
7. Solve problems of machine malfunction by following suggested procedure outline.

Code - 01.0301-20 AGRICULTURAL

Title - HAY AND FORAGE EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Mowers Objective #1 Identify the machine by make, model and serial number using the owner/operators manual and record this information legibly. Objective #2 Orally explain the function of machine parts or components during class discussion. Objective #3 Properly hitch machine to power source demonstrating observance of correct safety practices. Objective #4 Select and use the recommended lubricants, perform the necessary service procedures for the machine. Objective #5 Describe the various types of each machine used by farms in the area and indicate advantages and/or disadvantages of the different machines. Objective #6 Demonstrate ability to operate a machine and locate a malfunction needing correction. Objective #7 Solve problems of machine malfunction by following suggested procedure outline.	A. Types B. Mower construction and operating principles . Frame . Cutter bar assembly . Drives . Slip clutch devices . Lift C. Operation and daily maintenance . Hitching . Mowing . Lubricating . Safety D. Adjustment and repair . Lead . Register . Section and guard . Heights of cut

EDUCATION

01.0301-20 - Code

HAY AND FORAGE EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Review texts with students, which are listed as references for this module, and use the discussion questions or topics at the end of chapters. B. Preview film strips or films as listed in references for this module. C. Refer to actual machines brought in for students study and shop work indicating variations, etc. (Make proper use of the Owner Manual) D. Demonstrate the proper method of hitching a particular mower. E. Explain the correct method of opening a field, proper rate of speed of machine. F. Demonstrate the lubrication and checking for additional lubrication. (excessive wear) G. Demonstrate how to check cutter for alignment and knife register. H. Demonstrate the method of replacing guards and knife sections.	A. Study student texts as listed in references for this module and also owners manual provided for the machine to be studied and worked on in the shop. B. Be able to identify the machine and the various parts or assemblies that make up the machine. C. Hitch a mower and demonstrate ability to recognize safe procedure in preparation for operation. D. Correctly lubricate a mower and look for places that need further or corrective lubrication. E. Refer to Owner Manual provided with machine and check the adjustments according to the manufacturer's specifications. F. Repair and/or replace parts necessary to make machine more useful and longer lasting.	A. Identify machine and parts. B. Explain the operation of the machine and the function of the various assemblies. C. Check for proper hitching and observance of safety. D. Observe students ability in performing the jobs necessary to service the machine.

Code - 01.0301-20 AGRICULTURAL

Title - HAY AND FORAGE EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 2 - Conditioners (The same objectives will apply (1 - 7) for this unit)	A. Types B. Construction and operating principles . Chassis . Rolls . Lift . Drive . Slip Clutch devices C. Operation and daily maintenance . Hitching or driving . Transporting . Field operation . Lubrication . Safety D. Adjustment and repair . Header . Drive belts or chains . Reel . Rolls . Pick up or sickle bar

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Follow similar procedure as outlined in **A** through **F** for mowers. B. Further, procedure with all machines in this module could be as follows: . Operate the machines in the field noting any malfunctions in operation. . Inspect the machine noting worn and broken parts and parts that are out of line or adjustment. . Follow the operator's and manufacturer's service manuals, make the necessary repairs and adjustments. . Lubricate the machine for field operation . Test the machine in the field and make any adjustments necessary for proper operation. C. Discuss - . What is a hay conditioner or hay crimper? . How it crimps or conditions the hay. . What adjustments are required to do good work in varying conditions? . What rules of safety pertain only to the operation of the hay conditioner?	A. Repeat activities as outlined in 1 through 7 above. B. Prepare a list of items to be discussed in class with instructor and other students.	A. Written quiz in which student can name the types of conditioners and list some advantages and disadvantages of each. B. Observe student operating machines and give credit accordingly on ability of proper operation and safe practices. C. Give credit for written report indication malfunctions located and corrective measures taken.

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Rakes (The same objectives will apply (1-7) for this unit)	A. Types B. Construction and operating principles . Reel . Teeth . Basket . Drives . Wheels C. Operation and daily maintenance . Hitching . Transporting . Field operation . Lubrication . Safety
Unit 4 - Balers (The same objectives will apply (1-7) for this unit)	A. Types B. Construction and operating principles . Pickup mechanism . Feeding mechanisms . Compression mechanisms . Tying mechanism . Power drive system . Chassis C. Operation and daily maintenance . Hitching . Transporting . Field operation . Lubrication . Safety D. Adjustment and repair . Pick up . windguard . guide wheel . flotation . Feeder . Plunger . Knotter assembly . Needles . Clutch . Stripper bar alignment . Teeth . Bearings E. Variations and Accessories . Throwers or kickers . drives . adjustments

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Repeat steps A and B above, for the rake. B. Discuss - . What is meant by "air curing" hay? . How should the teeth of the semi-integral side - delivery rake be set in relation to the ground surface? . What is a sulky or dump rake? . What is the purpose of the bale measuring wheel and how it is regulated?	A. Repeat activities as outlined for mowers above.	A. Repeat procedures as outlined above for mowers and apply to rakes.
A. Repeat steps A and B above, for the baler. B. Discuss - . What is the need of the twine tying baler? . How the baler works? . What does the floating auger accomplish? . Explain how a knot is tied?	A. Repeat activities as outlined above for mowers and apply to balers.	A. Repeat procedures as outlined above for mowers and apply to balers.

Code - 01.0301-20

Title - HAY AND FORAGE EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Forage Harvesters (The same objectives will apply (1-7) for this unit)	A. Types B. Construction and operating principles . Header attachments . direct cut . window pickup . row crop . Feeding mechanisms . Chopping mechanism . cylinder . flywheel . flail . Blower . fan . drum . Drive assemblies C. Operation and daily maintenance . Hitching . Transporting . Field operating . Lubrication . Safety D. Adjustment and repair . Drive mechanism . Sickle head . Pick up head . Row crop head . Chopping mechanism . knives . shear bar . Fan and drum

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Repeat steps A and B above, for the Forage Harvester. B. Discuss - . What are two types of forage harvester operations? . How is the cutting unit driven? . How are knives sharpened? . What is the best blower type?	A. Repeat activities as outlined above, for the forage harvester.	A. Repeat procedures as outlined above, for the forage harvester.

Code - 01.0301-20

Title - HAY AND FORAGE EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 6- Forage Blowers (The same objectives will apply (1-7) for this unit)	A. Types B. Construction and operating principles . Frame . Fan . Housing . Feed hopper . Drive line C. Operation and Maintenance . Hitching . Transporting . Operating position . Lubrication . Safety D. Adjustment and Repair . PTO Clutch . Rotor drive gears . Paddle clearance . Flywheel RPM . Deflector at top of pipe
Unit 7 - Forage Wagons (The same objectives will apply (1-7) for this unit)	A. Types B. Construction and operating principles . Running gear . Box . Apron conveyor . Cross conveyor and beaters . Drive assembly C. Operation and Maintenance . Hitching . Transporting . Field operation . Lubrication . Safety D. Adjustment and Repair . Apron conveyor drive chain . Cross conveyor drive chain . Beater drive chain . Ratchet drive . Beater clutch . Replacing conveyor chains

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Repeat A and B above, for the forage blower. B. Discuss - . How to determine pulley diameter and speed? . Estimating the power requirements to run a blower.	A. Repeat activities as outlined above, for the forage blower.	A. Repeat procedures as outlined above, for the forage blower.
A. Repeat steps A and B above, for the Forage Wagon. B. Consideration - . This would be an excellent time to use the Study Guide developed by E. B. Hundtoft of Cornell - #363 a supplement to Agr. Engineering Bulletin #363 "Basic Consideration in Selecting Field Equipment" for Handling Hay Crops.	A Repeat activities as outlined above, for the forage wagon.	A. Repeat procedures as outlined above for the Forage Wagon.

MODULE OF INSTRUCTION

Title - HAY AND FORAGE EQUIPMENT Code - 01.0301-20

RESOURCE MATERIALS

A. Books - Teacher References:

1. Machines for Power Farming 2nd Edition, Stone and Gulvin, J. Wiley and Sons, Inc. New York, New York.
2. Principles of Farm Machinery, Bainer, Kepner, Barger, J. Wiley and Sons, Inc. New York, New York.
3. Power to Produce the Yearbook of Agriculture 1960, The United States Department of Agriculture, Washington, D.C.
4. Farm Power and Machinery Management, 4th Edition, Donnell Hunt,
5. Module #11, Adjustment and Maintenance, and Repair of Crop Harvesting Machinery, the Ohio State University, Columbus, Ohio.

Student references:
1. Farm Machinery and Equipment, Harris P. Smith, McGraw-Hill Book Co., New York, New York.
2. The Operation, Care, and Repair of Farm Machinery, The John Deere Co. Moline, Illinois
3. Mechanics in Agriculture, Lloyd J. Philipps, The Interstate Printers and Publishers Inc., Danville, Illinois.
4. Selecting and Maintaining Field Mowers, Turner, Smith and Wren, AAAEVA, Athens, Georgia.
5. Owner/Operators' Manuals, various manufacturer's of agricultural equipment.

B. Bulletins -
Teacher references-

1. Teachers supplement to Engineering Bulletins 363,364 and 365, E.B. Hundtoft, Cornell University.
2. A Summary of Methods and Results, 1963 Forage Harvesting Program, E. B. Hundtoft, Dept. of Agricultural Engineering, Cornell Univ.
3. Triple - Check Service-Balers, New Holland Machine Co. New Holland, Penn.
4. GSS-1053 Mower Cutter Bars; GSS-1120 Pickup Balers; GSS-1348 Balers, International Harvester Co., Chicago, Illinois

RESOURCE MATERIALS (continued)

B. Bulletins - (continued)

Student references:

1. EL-385 Add Zip to Your Mower; EC-463 Crush Your Hay, Purdue University, LaFayette, Indiana.
2. #339 Hay Conditioners, #363 Basic Consideration in Selecting Field Equipment, Department of Agricultural Engineering, Cornell University, Ithaca, New York.

C. Periodicals -

1. American Agriculturalist, Ithaca, New York
2. Agway Cooperator, Syracuse, New York
3. Successful Farming, DesMoines, Iowa
4. The Farm Journal, Philadelphia, Penn.
5. Hoard's Dairyman, Fort Atkinson, Wisconsin
6. Implement and Tractor, Interec Publishing Corp. Kansas City, Mo.

D. Audio-visuals -

1. Reconditioning a Mower, 42 min. B&W film, Purdue University, LaFayette, Indiana.
2. Modern Hay Baling with Plastic Twine, 18 min. color film, Sterling Movies USA Inc. , New York, New York.
3. Silver Anniversary, New Holland Machine Co., New Holland, Penn.

RESOURCE MATERIALS (continued)

B. Bulletins - (continued)

Student references:

1. EL-385 Add Zip to Your Mower; EC-463 Crush Your Hay, Purdue University, LaFayette, Indiana.
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3. Silver Anniversary, New Holland Machine Co., New Holland, Penn.

MODULE OF INSTRUCTION

Title - GRAIN HARVESTING EQUIPMENT Code - 01.0301-21

DESCRIPTION:

This module deals with the operation, service and repair of the combine. Students will study the development, types, principle operations, and other operations of the machine and determine the advantages and disadvantages of each. Using actual machines, the student will adjust, service and repair this equipment. Trouble-shooting procedures for correcting mal functions and overcoming the various losses encountered with combining will be included.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocation Class	Time Allocation Other
1. Development of the Combine	1	
2. Basic Design of Combine	1	1
3. Principle Units and Functions	1	2
4. Adjusting and Operating	0	10
5. Servicing and Repairing	2	12
	5	25

Revised June, 1974

MODULE OF INSTRUCTION

Title - GRAIN HARVESTING EQUIPMENT

Code - 01.0301-21

OBJECTIVES to be obtained:
The student will be able to:

1. Explain how and why the combine was developed.
2. Identify machines according to type, size, and capacity on sight in the shop or field.
3. Name the six different units of the combine and describe the functions of each.
4. List the six most important points of adjustment necessary on a combine.
5. Explain the method or procedure of adjustment to the machine as recommended in the owner/operator's manual.
6. Demonstrate ability to operate a combine in the field and identify where a gain loss is occurring.
7. Use the work plan as outlined by the instructor for servicing and/or repairing the combine in the shop or field.

Code - 01.0301-21

Title - GRAIN HARVESTING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
1.Development of the Combine Objective 1 Explain how and why the combine was developed	A.History- The modern combine is the result of centuries of development in grain harvesting methods. Two paths of progress have brought us from primitive hand tools to an efficient, fast working power machine. Early form--reaper started use of power--animal power for cutting grain 1836 the first combine built in Michigan 1846 first commercial production of reaper 1854 combine shipped to California 1920 through 1935 still big acreage machine 1935 first one-man combine powered by a two-plow tractor
2.Basic Design of the Combine Objective 2 Identify machines according to type, size and capacity on sight in the shop or field	A.Types .Tractor-drawn--P.T.O.driven .Tractor-drawn--own engine driver .Self-propelled--propelled and driven by its own engine or-- .Level-land .Hillside B.Sizes .Distinguished by the width of cut--5ft to 20ft swath .Weight of machines--3000 to 9000 pounds .Power-- 30hp to 60 or 75hp C.Capacities--rate of work .Certain size depends on many factors .Kind and condition of the crop .Topography .Moisture conditions Example: 14-ft,self-propelled machine "can combine" 20 to 30 acres of wheat in a day

E D U C A T I O N

01.0301-21 - Code

GRAIN HARVESTING EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A.Review references listed at the back of this module and review information that is available from the colleges in the form of bulletins,the various manufacturers. B.Obtain and show filmstrip titled "5,000 Years of Agricultural Machinery" available from NASCO, Fort Atkinson,Wis.,this is history from beginning to our times of machines used in agriculture. C.Bring a combine in to the shop or outside work area for use in explaining the construction, operation,etc. of the machine.	A.Study references assigned, take notes on instructors lecture and/or filmstrip presentation of the development of the combine. B.Provide a combine from the home farm for use in the shop for this module. (bonus credit can be given for this provision)	A.The student is tested on his knowledge of the development of the combine by preparing a written statement of "How" or "Why" the machine was developed.
D.Have students bring owner/ operator manuals from the home owned or neighbor owned combines to class and study for comparison with machine brought into the shop. E.Open up compartments,remove hoods,leaders,etc,to a point where all the movable parts can be seen, but yet,still functional.Demonstrate the operation of these parts before the class. F.Identify by pointing out and naming the various parts of the combine for the students list in their notes. Suggestion: Refer to reference-"Combines and Combining"for illustrations that can be copied for use by students in their notebooks to identify parts,components,mechanisms,etc.	A.Provide an operators manual for combine used at home or by a neighbor for use in class and shop work. B .Observe demonstration by instructor of the identification of combine parts,mechanisms, etc,and list in notebook for future reference.	B.A quiz using a flow chart or other illustration for student to identify parts,etc.such as that on page 24 of"Combine and Combining"

Code - 01.0301-21

AGRICULTURAL

Title - GRAIN HARVESTING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
3.Principle Units and Functions Objective 3 Name the six different units of the combine and describe the function of each.	A.Assemblies of combine .Cutting (or leader) .Feeding unit .Threshing unit .Separating unit .Cleaning unit .Grain handling unit B.Mechanism functions and component parts .Header--cuts standing grain and delivers it to the feeding unit .reel .dividers .cutter bar .Feeder--carries the cut grain from the cutter bar and feeds it evenly into the cylinder .canvas conveyor(draper) .Thresher--removes the grain or seed from the head or pod .cylinder -spike tooth -rasp bar -angle bar .concaves and grates .Separating--removes the grain from straw that is passed by the concaves due to the force of material moving through machine .Cleaning--removes the chaff and fine residue from the threshed grain .grain pan .chaffer .chaffer extension .tailings auger .shoe sieve .fan .Grain-Handling-conveys the threshed,clean grain to the point at which it is taken from the combine .clean grain auger .clean grain elevator .grain tank and unloader or bagger and bag chute

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
G.List the assemblies or mechanisms on the chalk board. Have students try to describe the functions of each of these units. H.Discuss- ..Why is "Safety First" a good motto for combine operators and servicemen? .What is an auger-type platform? .What is the cylinder and what does it do? .What is a rasp bar? .Describe the windrow method of combining. .How may the tractor operator aid in doing a clean job of harvesting? I.Show the film"This Business of Gleaning",18min color, from Allis-Chalmers Manuf.Co.,Milwaukee, Wis.,which describes the evolution of today's self-propelled combines.	E.Review notes and other reference materials on the units and/or component parts of combine and be prepared to describe the functions F.Be alert to the various hazards that exist around the combine and make a list of safety precautions as they are discussed. G .Bring to class any magazine articles,or newspaper items that are related to combines and their use,etc.	A.Have students list the names of the six assemblies of the combine and then explain how each performs its job.

Code - 01.0301-21

AGRICULTURAL

Title - GRAIN HARVESTING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
4.Adjusting and Operating Combines Objective 4 List the six most important points of adjustment necessary on a combine.	A.Procedure of adjustment .Reel-- .height varies with crop .speed in relation to travel .Cutter bar height .for saving straw .getting all the leads .Feeding .canvases-tight,prevent slipage .platform auger--raise or lower,speed variation important .Threshing .correct cylinder speed--wide range 350 to 1600rpm .crop conditions-require different speeds,etc. .regulate speed accurately .clearance between cylinder and concaves .Separating .proper speed-check adjustment,some machines can be adjusted .set the deflectors(retarders)-set low as possible,without causing clogging
Objective 5 Explain the method or procedure of adjustment to the machine as recommended in the owner/operators manual	.Cleaning .set the openings in the chaffer wide enough to allow grain through .set extension openings so that straw and weed stems float over .set tail board to prevent threshed grain from blowing out .adjust the angle and size of the openings in the shoe sieve .regulate air blast as recommended in the operators manual

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
J .Demonstrate,if possible,proper and improper combine operation under field conditions. K .Explain that a proper procedure should be followed for adjustment,a definite order must be followed in making adjustments if losses are to be reduced to a minimum.Assuming that the machine is in good mechanical condition,the first thing to check is: .Machine speed(RPM) Refer to instruction manual for the machine to find the recommended(RPM) speed. Adjust throttle so that speed is 15 to 20 RPM above recommended when machine is empty. After the PTO or engine speed is set correctly,check the speed(RPM) of the strawrack,cylinder,fan and beaters then adjust these to recommendations found in manual. Use a speed counter on the individual shafts to check all speeds.	H .Observe instructors demonstrations and explanations of machine operations. I .Refer to owner/operators manual and check for the manufacturers recommendations for the machine you are acquainted with on the farm.	D.A matching type of giving could be used to check the students knowledge of the important adjustments.
L .Discuss-- .Will a certain cylinder speed always be the correct speed for one particular crop--such as wheat? .Are all combines equipped with the same method of speed adjustment?	J .Participate in discussion of questions posed by instructor and/or fellow students.	E.Check students efforts in making adjustment by having him explain orally what has to be done and the effect it will have on the operation.

OBJECTIVES BY UNIT	CONTENT
Unit 4 (cont.) Objective 6 Demonstrate ability to operate a combine in the field and identify where a grain loss is occurring.	B.Operation An operator should be very concerned and have an understanding of the sources of grain loss and how to correct them. .Cutter bar loss .Cylinder loss .Rack loss .Shoe loss .Preharvest loss
Unit 5 Servicing and Repairing the Combine . Objective 7 Use the work plan as outlined by the instructor for servicing and/or repairing the combine in the shop or field.	A.Lubrication . Need for lubricants . Chart in owner manual ..Kinds of lubricants necessary B.Field repairs .Cutting and feeding unit .Threshing mechanism .Separating mechanism .Cleaning mechanism .Elevators,clutch,and gears C.Care of the **combine** after harvesting season .Visual inspection for minor and/or major repairs .Clean machine thoroughly D.Check and test unit component parts for wear,such as: Example: .Cutter bar: .condition of sections .guard plates, and guards .check register E.Ordering Repair Parts .Make a list of needed parts-order during off season .Give model and serial number and date of purchase, if original owner

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
M.Refer to the reference"Combines and Combining",page 25, and explain the causes of grain loss, how these losses can be measured.		
N .Demonstrate how the losses are determined in the field using the illustrations on page 32 and the Record Sheet on page 33 of the above mentioned reference.	K..Observe and participate in the instructors demonstration on grain losses and be prepared to check your own combine or that assigned for this module.	F.Have student operate a combine in the field and then have him determine where he has a cause of grain loss.
O .Bring into the shop or outside work area,several combines that need servicing and repairing.Demonstrate servicing through the following procedures. • Operate the machine in the field noting any malfunctions in operation. • Inspect the machine noting worn and broken parts that are out of line or adjustment. . Following the operators and the manufacturers service manual, make the necessary repairs and adjustments. .Lubricate the machine for field operation. .Test the machine in the field and make any adjustments necessary for proper operation.	L.Get complete details of the procedure demonstrated by the instructor for servicing and/or repairing the combine assigned. M.Review units on lubrication pertaining to oil viscosity, additives,and selection. Refer to the lubrication charts in the owner's manual.	G.A visual check of the student during servicing or repairing of the machine and of the completed job will give sufficient indication of attaining the objective.
P.Emphasize safety in all work being performed and especially around moving parts such as the cutter bar or cylinder.	N.Practice safety in all work especially with fellow students working on the same machine.	
Q.Demonstrate correct method of securing the make,model and serial number of the machine for purposes of ordering the correct parts.	O.Locate and record the correct information for ordering replacement parts.	

MODULE OF INSTRUCTION

Title - GRAIN HARVESTING EQUIPMENT Code - 01.0301-21

RESOURCE MATERIALS

A. Books:

Teacher references:

1. Farm Power and Machinery Management, 4th Edition Donnell Hunt, Iowa State University Press, Ames, Iowa
2. Principles of Farm Machinery, Bainer, Kepner, Barger, J. Wiley and Sons, Inc., New York, New York
3. Machines for Power Farming, 2nd Edition, Stone and Gulvin, J. Wiley and Sons, Inc., New York, New York
4. Mechanics in Agriculture, Lloyd J. Phipps, The Interstate Publishers & Printers, Inc., Danville, Ill.

Student references:

1. Farm Machinery and Equipment, 5th Edition, N. P. Smith, McGraw Hill Book Co., New York, New York
2. The Operation, Care and Repair of Farm Machinery, The John Deere Co., Moline, Ill.
3. Farm Shop Skills, Sampson, Mowery, Kugler, American Technical Society, Chicato, Illinois
4. Manufacturers, Owners and Service Manuals - various

B. Bulletins:

Teacher references:

1. Combines and Combining, Harlan F. Ridenour, Curriculum Materials Service, Ohio State Univ., Columbus, Ohio

Student references:

1. 4-H tractor program manual 4th year, Farm Machinery Care and Safety, Extension Service, Cornell University, Ithaca, N.Y.

C. Periodicals:

1. American Agriculturalist, Ithaca, N.Y.
2. The Farm Journal, Philadelphia, Pa.
3. Successful Farming, DesMoines, Iowa
4. Agway Co-operator, Syracuse, N. Y.
5. Hoard's Dairyman, Fort Atkinson, Wis.
6. Implement and tractor, Interter Publishing Corp., Kansas City, Mo.

D. Audio-Visuals:

1. 5000 Years of Agricultural Machinery, NASCO, Filmstrip, 94 frames, Fort Atkinson, Wis.
2. Combines and Combining, 30 slides, The Ohio Agricultural Education Curriculum Material Service, Ohio State Univ., Columbus, Ohio
3. This Business of Gleaning, 18 min. color film, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

MODULE OF INSTRUCTION

Title - GRAIN HARVESTING EQUIPMENT Code - 01.0301-21

RESOURCE MATERIALS

D. Audio-Visuals: (cont.)

4. More Grain in the Grain Tank, 15min. B&W film,
   Purdue Audio-Visual Center,Purdue Univ.,Lafayette, Inc.
5. Of Progress and Plenty, 20min color film, International Harvester
   Co., Chicago, Illinois

MODULE OF INSTRUCTION

Title - AGRICULTURAL EQUIPMENT ACCESSORIES Code - 01.0301-22

DESCRIPTION:

Organized instruction in the installation, maintenance and repair of agricultural equipment accessories. These learnings will relate to the needs of an agricultural dealership.

The instructor will select the agriculture equipment accessories for his location. He must also determine if safety, electrical and hydraulic review must be covered in class before working on the accessories selected.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Agriculture Equipment Accessories	3	27

Revised June, 1974

MODULE OF INSTRUCTION

Title - AGRICULTURAL EQUIPMENT ACCESSORIES   Code - 01.0301-22

OBJECTIVES to be obtained:

The student will be able to:

1. Follow manufacturers instruction sheets for installing agriculture equipment accessories.
2. Perform basic electrical wiring as required to install, maintain and repair agriculture equipment accessories.
3. Connect to the hydraulic system involved for the equipment accessories assigned.
4. Select the tools for all agriculture equipment accessories that are assigned.
5. Make adjustments and repairs to the equipment accessory being installed on a certain piece of equipment.
6. Demonstrate safety habits in shop while working with equipment accessories.

Code - 01.0301-22

Title - AGRICULTURAL EQUIPMENT ACCESSORIES

OBJECTIVES BY UNIT	CONTENT
Unit 1. Accessories Objective 1 Follow manufacturers instruction sheets for installing agriculture equipment accessories Objective 2 Perform basic electrical wiring as required to install, maintain and repair agriculture equipment accessories Objective 3 Connect to the hydraulic system involved for the equipment accessories assigned Objective 4 Select the tools for all agriculture equipment accessories that are assigned Objective 5 Make adjustments and repairs to the equipment accessory being installed on a certain piece of equipment Objective 6 Demonstrate safety habits in shop while working with equipment accessories	A. Manufacturers Instruction Sheets for the agriculture equipment accessories must be provided - . Bale thrower for the baler . Front-end loader for the tractor . Cab for powered unit . Air conditioner . Heater . Radio . Horn . Cigarette lighter . Molasses mixer adapter for portable feed grinders . Magnetic plates for portable feed grinders . Dual - wheels . Adjustable rear wheel spin-out for tractor . Pan and straw shredder for manure spreader or combine . Wheel weights for the tractor . Tires . Others as needed **Factors to Consider** . All phases of safety . Review of electrical wiring . Review of hydraulic systems and operation . Installation and adjustments . Maintenance . Repair

01.0301-22 - Code

AGRICULTURAL EQUIPMENT ACCESSORIES - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
The instructor will give short lectures, demonstrations and discussions. . Safety . Special tools . Basic electrical wiring . Basic hydraulics . Manufacturer's instructions pertaining to the agriculture equipment accessories selected	Students will be required to have "live" work - either provide them or have them provided. All of the module will be devoted to the individual student's particular live work.	A. The agriculture equipment accessory assigned or selected by the student must be correctly installed and adjusted and working properly. B. The instructor will keep a check sheet of the student's progress on each accessory. C. The student will be checked on the use of special tools. D. The student will be evaluated on his safety practices.

MODULE OF INSTRUCTION

Title - AGRICULTURAL EQUIPMENT ACCESSORIES Code - 01.0301-22

RESOURCE MATERIALS

A. Books -

Fundamentals of Service Electrical System	John Deere Co.	Moline, Ill.
Fundamentals of Service Hydraulics	John Deere Co.	Moline, Ill.
Mobile Hydraulic Testing	R.E. Glenn J.E. Blinn	American Technical Society Chicago, Ill.
Suggestions for Teaching "Electrical and Basic Controls Used in Agr. Production"	Edison Electric Institute	750 Third Ave. New York, New York 10017
Tractors and Crawlers	Eshelman	American Technical Society Chicago, Ill.

B. Audiovisuals -

Fundamentals of Service Hydraulic Visuals	John Deere Co.	Moline, Ill.
Master Set of Slides	International Harvester Co. (Implement Dept.)	180 N. Michigan Ave. Chicago, Ill.

MODULE OF INSTRUCTION

Title - LAWN AND GARDEN EQUIPMENT

Code - 01.0301-24

DESCRIPTION:

This module is designed to acquaint the student with the set-up, adjustments, repair and operation of lawn and garden equipment. Equipment such as lawn mowers, tillers, fertilizer spreaders, sprinklers and snow blowers will be used. He will become familiar with the common types of transmissions, clutches and drives, and will learn to adjust and repair them.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Types	1	2
2. Set-up, adjustment and lubrication	3	8
3. Drive mechanisms	1	3
4. Special cutting mechanisms	1	4
5. Equipment operation	1	6
	7	23

Revised June, 1974

MODULE OF INSTRUCTION

Title - LAWN AND GARDEN EQUIPMENT Code - 01.0301 24

Objectives to be obtained:

The student will be able to:

1. Identify 20 types of lawn and garden machinery and list the jobs that these machines do.

2. Set up, adjust and maintain 20 types of lawn and garden equipment according to specifications.

3. Study the drive mechanisms, belts, clutches, hydraulic drives, etc. and properly adjust and service these systems.

4. Work with the special cutting mechanisms and properly sharpen and service these mechanisms.

5. Operate and demonstrate the use of 20 types of lawn and garden equipment.

6. Develop safe operating practices and explain these to a customer for all types of lawn and garden equipment.

Code 01.0301-24

Title - LAWN AND GARDEN EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
1. Types 1. The student will identify 20 types of lawn and garden machinery available and list the jobs these machines do.	A. Lawn mowers-rotary . Rider . Push type . Self-propelled-walk behind B. Lawn mowers-reel . Pull type . Self-propelled-walk behind C. Lawn mowers-hammer knife D. Rotary tillers . Attaching type . Walk behind E. Lawn vacuums and blowers F. Mulchers and shredders G. Sprayers . Insects . Weed H. Sprinklers and small irrigation I. Loaders . Front end type . Rear mounted forklift type J. Spreaders-fertilizer . Drill type . Broadcast type K. Plows . Moldboard type . Snow L. Cultivators M. Sweepers N. Snow blowers-attaching type -walk behind O. Seeders-broadcast type -drill type P. Spikers and aerators Q. Stone rakes R. Thatchers S. Earth leveling machines T. Trenchers U. Post hole diggers V. Edge trimmers

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Types and Uses of Equipment: Lecture-explain use of various types Company product literature Slides if available from local dealers Motion pictures from companies-ask local dealers for these Students check advertisements for products	Visit a large local dealership (if available in the area to observe such things as: .Shop facilities and layout .Specialized tools & equipment used .Service policies for customer service .Employment opportunities .See equipment not available for class to work on	The student will list the names of 20 types of lawn and garden equipment in general use

OBJECTIVES BY UNIT	CONTENT
2. Set Up 2. The student will set up, adjust and maintain 20 types of lawn and garden equipment according to specifications	A. Equipment . Lawn mowers . Snow blowers . Rotary tillers . As many other types of equipment as available B. Selection of . Oils . Greases . Hydraulic fluids
3. Drive mechanisms 3. The students will study the drive mechanisms, V-belts, clutches, hydraulic drives, etc. and properly adjust and service these systems.	A. Transmissions B. Transaxles C. Differentials D. Disc. E. Hydraulic drive F. Sizes and types of V-belt G. Alignment H. Tension I. Types of clutches . Disc . Belt J. Adjustment K. Repair L. Installation of hydraulic drives M. Fluid levels and fluid types N. Repair

EDUCATION

01.0301-24 - Code

LAWN AND GARDEN EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Help students follow instructions during set-up Demonstrate bolt and nut types by markings and explain why they go in a particular place Lecture and motion picture films from oil companies Lecture on oil classification system	A.Have local machinery dealers bring in machinery for set up B.The student will set up and correctly adjust the machinery C.Demonstrate proper lubrication procedures D.Students lubricate machines that have been set up or repaired.	The quality of the students set up job, the time factor and workmanship will be graded by the instructor
Demonstrate to students how to interpret set up and repair manuals. Demonstrate proper use of special repair tools Explain tolerances,torques, backlash,etc.using slides and demonstration Demonstrate installing and adjusting of V-belts tension Show a belt that was used improperly adjusted if available Demonstration of proper repair and adjustment of clutches Use slides for clutch wear analysis. Explain principle of operation of hydraulic drive Lecture,slides,overhead transparencies,company manuals.	A.Attach drive mechanisms and properly adjust. Disassemble and reassemble the different types of transmissions. Repair broken units B.Students properly select and install vee-belts C.Students repair and adjust clutches and identify different types D.Students follow installation instructions and install a hydraulic drive unit. E.Students fill and check fluid levels on hydraulic units F.Students repair units, hydraulic hoses,etc.	The student will be graded for his workmanship on these maintenance service projects.

Code - 01.0301-24

A G R I C U L T U R A L

Title - LAWN AND GARDEN EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
4.Special cutting mechanisms 4.The student will work with the special cutting mechanisms and properly sharpen and service these mechanisms.	A.Lawn mower blades .Rotary .One balancing .Reel knives and shear bar B.Sickle bar and knife sections C.Hammer knives . Augers .flights .points D.Trencher teeth
5.Equipment Operation 5.The students will operate and demonstrate the use of 20 types of lawn and garden equipment	A.Operation and use of all available lawn and garden machinery B.Machinery manual study of safety shields and safety procedures
6.The student will develop safe operating practices and explain these to a customer for all types of lawn and garden equipment	

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Demonstrate proper sharpening and balancing of rotary mower blades stressing safety practices. Demonstrate sharpening and replacement of knife sections. Demonstrate build up and hard surfacing with welding equipment of auger points,digger and trencher teeth.	A.Each student properly sharpen and balance a blade. B.Visit a lawnmower shop to see reel type mowers sharpened. C.The student will work with these cutting and digging devices and will learn to build up,grind and sharpen for proper machine operation.	The student will be graded for his workmanship on these sharpening and service projects.
Instructor will demonstrate proper safe operation of the machinery Instructor will point out dangerous situations Use of films,statistics,etc.	Students will work with the machinery and operate each type with special attention to safety shields,guards,etc.	The student will operate and demonstrate safe use of all types of lawn and garden equipment for his classmates and instructor and will be graded by instructor.

MODULE OF INSTRUCTION

Title - LAWN AND GARDEN EQUIPMENT Code - 01.0301-24

RESOURCE MATERIALS

Books - Mechanics Manual: Lauson Power Products - Tecumseh Products Co. - Parts Depot Division - Grafton, Wisconsin 53024

Lawn Boy Service Manual: Outboard Marine Corp. - Galesburg, Illinois 6140

Small Tractor Service Manual: Technical Publications Div. - Interte Publishing Corp. 1014 Wyandotte St., Kansas City, Missouri 64105

Briggs and Strattons Service Manual: W.J. Connell Co., 210 Needham St., Newton Upper Falls, Massachusetts 02164

John Deere Service Publications:

Periodicals -

Lawn and Garden: Intertec Publishing Corp.
1014 Wyandotte St.
Kansas City, Missouri 64105

1) Tractor and Implement:

2) National Safety Council Reports

Audiovisuals -

1) Film: Pennoil Co., Syracuse, New York

2) Slides: Caterpillar Co. - Syracuse, New York (show clutch wear, drive backlash, etc.)

3) John Deere - "Hydraulics"

MODULE OF INSTRUCTION

Title - MATERIALS HANDLING EQUIPMENT Code - 01.0301-23

DESCRIPTION:

This module will familiarize the student with common types of materials handling equipment in agricultural enterprises. Stress will be on the proper selection, installation, use, and maintenance of such equipment. When possible, students will gain practical experience in these three activities. They will develop plans for needs of such equipment, including costs, for a given situation. Equipment such as blowers, unloaders, conveyors, and barn cleaners will be involved.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Blowers and elevators	3	6
2. Conveyors	1	4
3. Bunk feeders	1	4
4. Barn cleaners	1	4
5. Manure handling systems	2	4
	8	22

Revised August 1975

MODULE OF INSTRUCTION

Title - MATERIALS HANDLING EQUIPMENT   Code - 01.0301-23

OBJECTIVES to be obtained:

The student will be able to:

1. List six types of silos
2. List two advantages of each of four types of silos
3. Identify three types of unloaders used in the school area to unload given materials
4. List all factors used in selecting an unloader for use with given materials
5. Compute the total feed capacity for a given farm business
6. Identify the common types of grinders, mixers, and meters used in livestock feed processing
7. Assemble and service a portable grinder
8. Be able to match volume of grain corn to be stored with the storage facility which will prevent spoilage losses in excess of normal amounts
9. List all factors used to select and service conveyors for a given job
10. Select bunk feeders based upon requirements, cost, and adaptability to a given system
11. Wire a control for a given barn cleaner
12. Identify four types of barn cleaners from diagrams of given operating systems
13. Use the operator's manual for maintaining given pieces of handling equipment
14. Identify 80% of the factors which influence the farmer when he selects a manure handling system
15. Plan a liquid manure system for a given farm and give recommendations as to its use
16. Operate the following types of materials handling equipment safely under actual working conditions: silo unloader, feed grinder, self unloading wagon, conveyor, and barn cleaner

Code - 01.0301-23

Title - MATERIALS HANDLING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Blowers and elevators Objective 1 List six types of silos	A. Storage areas . Silos . conventional tower
Objective 2 List two advantages of each of four types of silos	. concrete stave . monolithic concrete . wooden . steel . sealed storage tower . trench . bunker . pit . stack
Objective 3 Identify three types of unloaders used in the school area to unload given materials	. Silo unloaders . top unloaders . suspended . non-suspended . center chute . bottom unloaders . commercial trench unloader . bucket on tractor
Objective 4 List all factors used in selecting an unloader for use with given materials	. Selecting a silo unloader . capacity . motor size . storage space . transfer of unloader . return on investment in labor saved . available parts and service
Objective 5 Compute the total feed capacity for a given farm business	. Grain . bulk feed bins . analyze total feed requirements . determine necessary system capacity . basic ingredients . processed ration . examine types of bins . hopper bottom . flat bottom . number and type of augers or elevators needed

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Slides, bulletin references, class discussion of advantages, field trip review	A. Participate in class discussion B. Make notes of observations on field trips	A. Students will list types of silos. Students will list two advantages of each of the major types of silos used in your area.
B. Discuss types and advantages prior to the two field trips on silos		B. Students will identify the types of unloaders commonly used
C. Use "Things You Should Consider Before Buying a Silo Unloader" and Agricultural Engineering Extension Bulletin 348 as reference material for class discussion	C. Select an unloader for his farm or a cooperating farmer's silo and prepare rationale for his decision. Plan a silage handling system for a given farm situation. Using a cooperating farm or dealership, assist in assembly and installation of an unloader	C. Have students list the important items to consider before purchasing a silo unloader. D. Instructor assess student's plan E. Instructor or dealer assess thoroughness and accuracy of student's work
D. Visit a farm and inventory the feed requirements plus the basic ingredients he will need. Teachers may use a worksheet exercise. Follow with class discussion and lecture plus overhead transparencies	D. Participate in field trip and complete exercise	F. Instructor assess accuracy of the inventory and exercise sheet. G. Orally determine student's different types of bins and elevator systems.

OBJECTIVES BY UNIT	CONTENT
Objective 6 Identify the common types of grinders, mixers, and meters used in livestock feed processing	. feed grinders and mixers . batch method . continuous flow . mills . hammer . burr . roller . feed meters . auger meter . flat belt meter . fluted wheel meter . vibrating meter
Objective 7 Assemble and service a portable grinder	. Corn cribs . drying systems . heated forced air . slotted floor . types of construction . metal . wire . wooden . moisture content and storage form . shelled corn . corn and cob . high moisture corn . width . cleaning crib . Hay . locations . pole barn . conventional stable . steel building . silos . stacks . elevators . blowers . side unloading wagons
Unit 2 - Conveyors Objective 8 Be able to match volume of grain corn to be stored with the storage facility which will prevent spoilage losses in excess of normal amounts	A. Delivery conveyors . Type . auger . chain and flight . Cleaning . removal of spoiled material . not in path of other cleaning chores . Unloading speed control . Discharge distances for wagons . Capacity . Cost

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
E. Visit a feed mill to observe as many types of meters and mills as you can find. Follow with diagrams of operation and parts.	E. Participate in field trip F. Assemble, pre-delivery service, or repair and service a portable feed grinder	H. Student will identify the grinders, mixers, and meters in common use to the instructor's satisfaction I. Instructor assess accuracy of student's assembly and service in accordance with assembly instructions and service manual
F. Visit as many systems as available. Follow with class discussion and bulletin use	G. Read bulletin sections on corn cribs H. Participate in visits	
G. Instruction should be connected to the silos discussed earlier, especially for high moisture corn		
H. Visit locations, then use data in reference library to prepare reports	I. Students will present oral reports on each storage location including extra information on any item needed to make the system work	
A. Discuss factors in class and use slides, overhead, and charts B. Conduct one field trip to show conveyors and bunk feeders in operation. This should be done before much lecture or discussion.	A. Assemble and pre-delivery service, or repair and service one of the following: elevator, blower, self unloading wagon	A. Instructor determine if student has assembled and serviced the machine according to manual specifications B. Determine if the student correctly identified and serviced parts needing repair

Code - 01.0301-23

Title - MATERIALS HANDLING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
	B. Cross conveyors . Chain and flight . Auger . Belt C. Maintenance
Unit 3 - Bunk feeders Objective 9 List all factors used to select and service conveyors for a given job	A. Distribution units . Chain and flight . straight bunk . lazy susan . Auger . open type . tube . Shaker feeder . Open bunk for use with side unloading wagon B. Distance C. Roofing D. Cleaning E. Space requirements . Single side . Double side . Continuous feeding F. Maintenance
Unit 4 - Barn cleaners Objective 10 Select bunk feeders based upon requirements, cost, and adaptability to a given system Objective 11 Wire a control for a given barn cleaner Objective 12 Identify four types of barn cleaners from diagrams of given operating systems	A. Types . Push and pull . Paddle . Chain . Blade on tractor . Belts B. Motors . Sizes . Controls . Moisture Review motor section of electricity module C. Drainage D. Design of system E. Maintenance F. Dimensions of gutter

EDUCATION

01.0301-23 - **Code**

MATERIALS HANDLING EQUIPMENT - **Title**

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
	B. Student wire controls C. Draw diagrams of several systems	C. Instructor assess student's wiring
C. Use an operator's manual to demonstrate normal maintenance activities	D. Complete worksheet on information contained in operator's manuals	D. Instructor check. accurateness of worksheet
A. Discuss factors in class and use slides, overhead, and charts B. Utilize resource person for content on planning and building a system	A. Select bunk feeders for two given situations B. Adjust, service, and maintain a bunk feeder on the home farm or cooperating farm	A. Instructor react to appropriateness of selections B. Instructor determine if student has maintained feeder according to operator's manual specifications
C. Use operator's manual to demonstrate servicing needed		
A. List the types and explain general operation of each, including diagrams of operation	A. Take notes on types, advantages, and disadvantages of each type B. Be able to identify types of cleaners C. Wire a control	A. Written quiz B. Instructor assess student's floor plan of a system
B. Review motor requirements needed and show a control used, along with proper wiring technique C. Class discussion with literature provided by local dealer D. Discuss and demonstrate maintenance operator's manual directions	D. Lay out a floor plan of a system E. Learn to use the operator's manual	

Code - 01.0301-23

Title - MATERIALS HANDLING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Manure handling systems Objective 13 Use the operator's manual for maintaining given pieces of handling equipment Objective 14 Identify 80% of the factors which influence the farmer when he selects a manure handling system Objective 15 Plan a liquid manure system for a given farm and give recommendations as to its use Objective 16 Operate the following types of materials handling equipment safely under actual working conditions: silo unloader, feed grinder, self unloading wagon, conveyor, and barn cleaner	A. Value of manure B. Type of building structure C. Kind and amount of bedding D. Amount of water available E. Sanitation laws F. Solid manure . Paved slab . Loading ramp G. Liquid manure . Percent of water necessary . Components . Herd size . Physical structures . Investment per cow . Field conditions . Storage time . Capacity . Pumping . Parlor drain . Odors . Labor distribution . Agitation . Frozen manure . Slatted floors . Spreaders H. Lagoons . Aerobic bacteria . Anaerobic bacteria . Local regulations . Bedding . Size necessary I. Dehydration J. Incineration

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Use articles, filmstrips, overhead, discussion, lecture, class reporting. Discuss	A. Identify the methods of mechanical solid manure handling.	
B. Discuss all factors and compute storage facility size for specific situations. Stress this as a system which is either completely followed or not followed at all. There are many variations of systems and not all are legal--don't put a lot of money into a system which may not be legal to use. After field trip, again discuss the implications of this system.	B. Become aware of factors regarding liquid manure and their influence on decision making C. Participate in field trip and record notes D. Design a liquid system for a sample farm situation	A. Written quiz B. Instructor assess student's understanding of factors as used in the system designed
C. Class discussion; field trip, where possible regarding lagoons. Visit village treatment plant to view the operation. A field trip to visit contrasting systems		

MODULE OF INSTRUCTION

Title - MATERIALS HANDLING EQUIPMENT Code - 01.0301-23

RESOURCE MATERIALS

Bulletins -

1. Liquid Manure Systems in Free Stall Dairy Barns, Casler, A. E., Res. 218
2. Mechanical Equipment for Handling and Feeding Forage, Guest, A., Eng. Ext. 348
3. Things You Should Consider Before Buying a Silo Unloader, Brillion Service
4. Auger Conveyors for Feedlot Mechanization, Works, Idaho, Farm Elect. Leaflet 56
5. Feed Processing on the Farm, Works, Idaho, Farm Elect. Leaflet 60

MODULE OF INSTRUCTION

Title - LIGHT EARTHMOVING EQUIPMENT REPAIR AND MAINTENANCE

Code - 01.0301-25

DESCRIPTION:

This module will provide basic training in the repair and maintenance of light earthmoving equipment commonly used in logging, soil conservation, farming, and ornamental horticultural operations. Such items as the bulldozer, backhoe and log loader will be serviced. Also included will be fork lifts such as are used in agricultural storages.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Track and roller repair and maintenance	1	7
2. Steering clutches and brakes	1	6
3. Shuttle clutches and direction reversers	1	4
4. Hydraulic systems	1	9
	4	26

Revised June 1974

MODULE OF INSTRUCTION

Title - LIGHT EARTHMOVING EQUIPMENT REPAIR AND MAINTENANCE Code - 01.0301-25

OBJECTIVES to be obtained:

Students will be able to:

1. Repair certain components and maintain the light industrial equipment that might be sold at a farm equipment dealership.
2 Describe the operation of different types of clutch brake systems in light industrial equipment.
3. Demonstrate skills needed to service and repair tracks, clutches and brakes.
4. Describe the operation of hydraulic systems and demonstrate skills needed to service and repair these systems.

AGRICULTURAL

Code - 01.0301-25

Title - LIGHT EARTHMOVING EQUIPMENT REPAIR AND MAINTENANCE

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Track and roller repair and maintenance Objective #1 To perform the task of removing and replacing track Objective #3 Demonstrate skills needed to service and repair track.	A. Track pins and bushings B. Track rollers C. Track sprockets and idlers D. Track removal and replacement
Unit 2 - Steering clutches and brakes Objective #1 To be capable of determining type of steering system Objective #2 Describe the operation of different types of brakes Objective #3 Perform tasks of adjusting and realigning steering brakes.	A. Types of track vehicle steering B. Adjustment of track vehicle steering system C. Relining steering brakes

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Students safely remove track. B. Examine with students where and how components of track wear. C. Students safely replace track D. Demonstrate servicing and adjusting of track components.	A. Student practice and observation B. Student observation C. Student practice and observation D. Each student perform the service and adjustments needed.	A. Oral quiz on all components . Identification of part . Where wear will occur B. Successful servicing and accurate adjustments will be observed by the instructor.
A. Overheads from various service manuals showing types of track steering. B. Demonstrate adjusting steering brake and/or clutch. C. Have students remove and replace brake linings. Use new linings if needed.	A. Student observation B. Student observation C. Students remove, replace and adjust clutch	A. Teacher observation of student care and efficiency in practical exercise.

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Shuttle clutches and direction reversers Objective #1 Be capable of determining type of position of clutch Objective #2 Describe the operation of different types of brakes Objective #3 To perform tasks of adjusting and replacement of clutch.	A. Types of clutches and operating principles B. Adjustment C. Replacement
Unit 4 - Hydraulic systems Objective #1 To be capable of identifying components of a hydraulic system. Objective #2 To understand the principles involved in a hydraulic system Objective #3 **Demonstrate skills needed to service and repair tracks, clutches and brakes.** Objective #4 Describe the operation of hydraulic systems and demonstrate skills needed to service and repair these systems.	A. Principles of hydraulics B. Components of a hydraulic system C. Pump repair and/or replacement . Economics of repair vs replacement D. Hose replacement E. Cylinder repair F. Relief valve settings G. Trouble shooting

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion using overheads on types of shuttle clutches and direction reversers. B. Demonstrate adjusting clutch. C. Have students remove clutch and reline if needed.	A. Student observation B. Students remove, replace and adjust clutch.	A. Teacher observation of students care and efficiency in practical exercise.
A. Discussion using overheads on hydraulic systems . Principles . Components B. Show students an actual hydraulic system on a vehicle, name components. C. Demonstrate hose replacement D. Have students disassemble, repair and assemble cylinder E. Demonstrate setting relief valves F. Hand outs on trouble shooting G. Have students troubleshoot a poorly operating hydraulic system	A. Student observation. B. Divide students in groups of 3 for repair of cylinders C. Intentionally cut down performance on a system and have student teams troubleshoot (ideally should have several systems with problems)	A. Written quiz on principles and component identification B. Teacher observation of careful and efficient repair. C. Teacher observation of proper procedure in trouble shooting Students should identify 3 problems if possible

RESOURCE MATERIALS

A. Books -

Bedell, Earl & Frazee, Irving. *Tractors and crawlers.* American Technical Society. Chicago, Ill. 1963.

Manufacturer's Service Manuals.

B. Audiovisuals -

Motion picture and slide sets from Catapillar Tractor Co.

Overheads taken from Service and Repair Manuals of various makes of vehicles on:
- **Hydraulic systems**
- **steering brakes**
- **clutches**

MODULE OF INSTRUCTION

Title - PLANNING AGRICULTURAL STRUCTURES AND SERVICE FACILITIES   Code - 01.0302-01

DESCRIPTION:

The module is concerned with the selection and planning of suitable buildings and types of construction for specific agricultural purposes. Included will be building materials and methods, construction standards, site suitability and preparation, and cost estimates. Remodeling of existing buildings will be considered. The student will prepare sketches of an agricultural structure, including site layout and the location of equipment, water, light and electrical outlets. Construction skills are included in other modules.

Major Divisions or Units of Content	Time Allocation Class	 Other
1. Determine Structural Needs	4	4
2. Determine Construction Types, Materials, Sizes, and Site Location for Specific Purposes	6	6
3. Drawing Scale Plans for a Specific Building	2	8
	12	18

Revised August '75

MODULE OF INSTRUCTION

Title - Planning Agricultural Structures and Service Facilities

Code - 01.0302-01

OBJECTIVES to be obtained:

The student will be able to:

1. List the basic considerations for constructing functional agricultural structures.
2. Identify to the instructor's satisfaction basic types of agricultural buildings including the advantages and disadvantages of each.
3. List five of eight factors to consider in properly locating a structure.
4. Determine space required for a structure on his own site or a problem provided by the instructor.
5. Identify 80% of the major parts of a structure, given three of the basic types of buildings.
6. Demonstrate a knowledge of terms used in reference to structures by interviewing a contractor and recording all trade terms used by the interviewee.
7. Determine, to the instructor's satisfaction, the type of roof framing to use based on the needs of the structure.
8. Identify the types of foundations and wall supports, and select the type appropriate to his situation.
9. Identify the types of roofing material and list the appropriate uses of each to the instructor's satisfaction.
10. Select the kind of siding material to use on his building, given the types of siding and their uses.
11. Select size and type of doors and windows given the types and their uses.
12. Select type of floor needed, given types and their uses.
13. Compute and list a bill of materials for all components of the structure with 100% accuracy.
14. Draw to scale a preliminary sketch of the floor plan for a given agricultural building with 100% accuracy.

Code - 01.0302-01

Title - Planning Agricultural Structures and Service Facilities

OBJECTIVES BY UNIT	CONTENT
Unit 1 - **Determine Structural Needs** Objective 1 List the basic considerations for constructing functional agricultural structures.	A. Feasibility of remodeling B. Plans for expansion C. Degree of farm enterprise specialization D. Labor saved E. Market conditions F. Machinery available G. Building codes
Unit 2 - Determine Construction Types, Materials, Sizes, and Site Location for Specific Purposes Objective 2 Identify to the instructor's satisfaction basic types of agricultural buildings including the advantages and disadvantages of each.	A. Types of structures . Wood-frame . types . characteristics of each type . advantages . weaknesses . Masonry structures . types . characteristics of each type . advantages . weaknesses . Metal structures . types . characteristics of each type . advantages . weaknesses . Prefabricated structures . types . characteristics of each type . advantages . weaknesses

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion using specific farm examples. B. Field trip C. Resource person - building inspector	A. Take notes on class discussion. B. Interview a person who recently completed a building C. Record observation on field trips.	A. Oral quiz of students understanding of considerations.
A. Class discussion using charts and pictures of foundations, frames and roofs. B. Arrange for trips to buildings under construcion to observe foundations, frames and roofs. C. Illustrate types of wood frames by diagrams or pictures.	A. Make notes of class discussion. B. Participate in class trips to make observations. C. Sketch a diagram of each type of structure.	A. Written quiz on identifying types, characteristics, advantages, and disadvantages.

Code - 01.0302-01

AGRICULTURAL

Title - Planning Agricultural Structures and
Service Facilities

OBJECTIVES BY UNIT	CONTENT
Objective 3 List five of eight factors to consider in properly locating a structure.	A. Factors . Convenience . Protection from weather . Appearance . Fire hazard . Provision for expansion . Drainages . Availability of electrical service . Environmental conditions
Objective 4 Determine space required for a structure on his own site or a problem provided by the instructor.	A. Calculating square footage . For machinery storage B. . For animal housing . For crop storage . For an agri-business operation
Objective 5 Identify 80% of the major parts of a structure, given three of the basic types of buildings. Objective 6 Demonstrate a knowledge of terms used in reference to structures by interviewing a contractor and recording all trade terms used by the interviewee.	A. Base structure . Skids . Piers . Slabs . Footings . Foundation walls B. Main frame . Platform . Timber . Balloon C. Supports . Anchors . Joists . Sills . Headers . Girders . Bridging . Studding . Nailing girts . Wall plates . Angle braces D. Other structural parts . Windows . Doors . Stairs

01.0302-01 - Code

Planning Agricultural Structures - Title
and Service Facilities

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion	A. Use toy farm set-up to figure distances, convenience and practice other factors influencing location.	A. Instructor assess appropriateness of students placement of class problems.
A. Teacher demonstration of sample calculations. B. Supervise and assist students in independent calculations.	A. Inventory machinery, animals, crops to utilize the building B. Determine square footage required for items inventoried. C. Use cardboard cut-outs to lay out a functional design and determine space required.	A. Instructor check student's inventory for obvious omissions. B. Instructor check accuracy of calculations. C. Instructor determine if student design is functional. D. Assess student's attempt to investigate several alterations.
A. Class discussions using charts and pictures of parts. B. Point out parts during field trip to different structures.	A. Participate in class discussion taking notes. B. Make sketch notes of field trip noting parts. C. Interview a contractor regarding procedures, terms, and arrangements for building structures.	A. Written quiz on major parts of a structure. B. Oral quiz of student's awareness of contractors terms.

Code - 01.0302-01

Title - Planning Agricultural Structures and Service Facilities

OBJECTIVES BY UNIT	CONTENT
Objective 7 Determine, to the instructors satisfaction, the type of roof framing to use based on the needs of the structure.	A. Roof shapes • Shed • Gable • Off-center • Half-monitor • Gambrel • Arch B. Roof supports • Supported rafters • Trusses • Rigid frames C. Roof pitch • Definition • Minimum pitch • Figuring pitch D. Factors in selecting • Post-free width needed • Extra height • Provisions wind and snow load • Provision needed for strong joints • Provision needed for attaching roofing • Quality of framing required.
Objective 8 Identify the types of foundations and wall supports, and select the type appropriate to his situation.	A. Types of foundations and walls • Poles, or posts and piers • Wood frame with concrete foundation • Post and girt with concrete foundation • Masonry walls on concrete foundation • Steel structure B. Factors in selection • Ease of construction • Fire resistance • Resistance to decay • Provision for attaching siding • Resistance to wind and weight • Cost

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion including the advantages and disadvantages of each type. B. Supervise student independent study and determination of appropriate roof for problem situation. C. Demonstration of figuring pitch. D. Demonstrate use of tables to figure load capacity of spans using different material. E. Class discussion of each factor affecting selection.	A. Notes on class discussion B. Independent study to determine shape, supports and pitch for his project or class project. C. Figure pitch on class sample building as well as his project.	A. Written quiz on identification and use of roof shapes, factors to consider in selecting, and figuring pitch required. B. Evaluate accuracy and appropriateness of student's selections for his project including validity of reasons.
A. Class discussion of characteristics and uses of each. B. Supervise student independent study to select a foundation. C. Class discussion of each factor in selection..	A. Participate and keep notes on class discussion. B. Independently study each type, consider the factors affecting selection of foundations and walls and decide on option to use on his class project.	A. Orally determine student's understanding of use of various foundations and walls. B. Assess student's decision on project for appropriateness and accuracy of reasons.

Code - 01.0302-01

Title - Planning Agricultural Structures and Service Facilities

AGRICULTURAL

OBJECTIVES BY UNIT	CONTENT
Objective 9 Identify the types of roofing material and list the appropriate uses of each to the instructors satisfaction.	A. Roofing materials . Wood shingles . Asphalt shingles . roll . strip shingles . individual shingles . Roll roofing . Metal roofing . flat . v-crimp . corrugated . Cement asbestos
Objective 10 Select the kind of siding material to use on his building, given the types of siding and their uses.	A. Types . Wood siding . Masonry . Galvanized steel . Exterior plywood . Aluminum B. Factors to consider . Fire resistance . Maintenance . Paintability . Type of fastener needed . Life expectancy - weathering
Objective 11 Select size and type of doors and windows given the types and their uses.	A. Doors . Sliding doors . Overhead doors B. Windows . Construction types

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion B. Supervise individual student selection.	A. Visit building supply firm to see various types of roofing. B. Participate in class discussion and keep notes. C. Determine roofing for his individual class project.	A. Have student identify sample roofing material. B. Assess student's selection for his project.
A. Class discussion of uses, advantages and disadvantages. B. Lecture on the factors to consider. C. Supervise students selection of siding for class project.	A. Participate in class discussion and keep notes. B. Visit buildings in the community to inspect types of siding. C. Visit with building supplier to gather facts on each type of siding. D. Determine siding for his class project.	A. Have student identify samples of siding and discuss characteristics of each. B. Assess student's siding selection for his project.
A. Plan trip to local building materials dealer to observe types of doors and windows.	A. Research types of doors and windows including use and costs. B. Select doors and windows for class project.	A. Orally assess students knowledge of types of doors and windows and their use.

Code - 01.0302-01

Title - Planning Agricultural Structures and Service Facilities

OBJECTIVES BY UNIT	CONTENT
Objective 12 Select type of floor needed, given types and their uses.	A. Types . Wooden . Concrete . Dirt . Crushed rock . Wire
Objective 13 Compute and list a bill of materials for all components of the structure with 100% accuracy.	A. Procedure in determining costs . Consult experienced contractors . Secure local standard unit costs . Consult others in community . Price prefabricated buildings . Determine labor costs separately from material cost. B. Calculating construction cost . Masonry work and site preparation . Carpentry work . Sheet metal work and roofing . Insulation . Heating C. Calculating quantities D. Methods of calculating materials
Objective 14 Draw to scale a preliminary sketch of the floor plan for a given agricultural building with 100% accuracy.	A. Drawing . Drawing equipment . Conventional lines . Lettering . Symbols . Types of working drawings B. Sketching . Materials for sketching . Features of sketching

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Independent student study of floor appropriate to class project.	A. Independently study floor needs for building being planned.	A. Assess orally student's understanding of materials used for floors.
A. Secure from a contractor several copies of specifications for buildings. B. Secure several copies of building contracts. C. Arrange for contractor to talk with class. D. Secure prices of prefabricated buildings. E. Demonstrate figuring costs. F. Demonstrate figuring a list of materials.	A. Study a building specification and note items to include. B. Study a building contract and list items it covers. C. Calculate cost of all building components. D. Develop a list of materials for the project.	A. Written quiz on selected calculations. B. Assess accuracy of student's calculations. C. Assess completeness of list of materials.
A. Identify drawing equipment B. Demonstrate drawing techniques. C. Provide trainee experiences by assigning problems. D. Supervise drawing on class project.	A. Identify drawing equipment B. Practice techniques of drawing and lettering. C. Examine drawings used by contractors and builders. D. Draw class assigned structure. E. Draw student's project structure.	A. Instructor assess completeness and accuracy of drawings.

MODULE OF INSTRUCTION

Title - Planning Agricultural Structures and Service Facilities

Code - 01.0302-01

RESOURCE MATERIALS

Books:

Bulletins:

"Farm Utility Buildings"
American Association for Agricultural Engineering and Vocational Agriculture
Athens, Georgia 1969

"Practical Farmstead Planning and Farm Facts You Should Know"
Republic Steel Agricultural Extension Bureau
P. O. Box 7587
Birmingham 13, Alabama

"Farm Structures and Convenience - Construction, Maintenance and Repairs"
U.S. Department of Health, Education & Welfare
Office of Education 1967

"Estimating Construction Costs for Free Stall Dairy Systems"
Cornell University
Agricultural Engineering Extension Building
486 Casler 1968

Audiovisuals:

MODULE OF INSTRUCTION

Title - TRACTOR STARTING AND CHARGING SYSTEMS Code - 01.0301-28

DESCRIPTION:

The purpose of this module is to acquaint the student with the various types of starting and charging systems used on today's agricultural tractors. It will acquaint him with the fundamentals of electricity, its terminologies, and how it is used to perform specific jobs in the starting and charging system. He will be involved with actual components, dismantling, testing components, reassemble, and testing complete assemblies. These tests will be compared with manufacturers' specifications to determine required additional service. During this procedure he will become acquainted with proper test equipment. He will also be able to perform preventative maintenance on the components of both systems.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Electrical Theory	4	1
2. Electric Storage Battery	2	1
3. Charging System	5	10
4. Starting System	3	4
	14	16

Revised June, 1974

MODULE OF INSTRUCTION

Title - TRACTOR STARTING AND CHARGING SYSTEMS   Code - 01.0301-28

Objectives to be obtained:

The student will be able to:

1. Explain the principles of electricity and its relationship to magnetism
2. Identify the components of a storage battery, explain how it transmits energy, and perform necessary tests to obtain high efficiency using proper test equipment
3. Identify components of the charging system, explain the operational function of each, and perform tests to obtain maximum efficiency from the system by using proper test equipment. Compare actual tests with manufacturers' specifications.
4. Identify the major components of the starting system, explain the operational function of each, and perform tests to obtain maximum efficiency by utilizing proper test equipment. Compare actual test results with manufacturers' specifications.
5. Demonstrate ability to service and repair components of the above systems.

Code - 01.0301-28

Title - TRACTOR STARTING AND CHARGING SYSTEMS

OBJECTIVES BY UNIT	CONTENT
Unit 1 Theory Objective 1. Explain the principles of electricity and its relationship to magnetism	A . Define . Electricity . Electrons . Voltage and Current . Resistance . Conductors and Semi Conductors . Insulators . Circuits . Series Circuit . Parallel Circuit . Ohm's Law . Voltage Drop . Magnetism . Alternating and Direct Current . Basic Test Equipment . Safety Precautions
Unit 2. Battery Objective 2. Identify the components of a storage battery, explain how it transfers energy, performs tests to obtain maximum efficiency. Objective 5 Demonstrate the ability to service batteries.	A. Define storage battery B. Components of battery C. Types of batteries D. Procedure to activate a battery E. Testing a battery F. Battery storage G. Battery troubleshooting H. Charging a battery . Slow charge . Fast charge I. Battery ratings J. Safety precautions

EDUCATION

01.0301-28 - Code

TRACTOR STARTING AND CHARGING SYSTEMS - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture, utilizing chalkboard, charts or slides in discussing: . Molecular structure of electricity . Electrical characteristics . voltage . Current-Amperage . resistance . Materials used for electrical flow . Materials used for resisting electrical flow . Formulas used to calculate . Types of circuits . parallel and series . Principles of magnetism . magnetic field . electro-magnetic induction . "Right Hand Rule" . A.C and D.C. current B. Demonstrate use of volt, ampere and ohmmeter	A. Explain the characteristics of electricity. B. Identify sample . Conductors and semi-conductors . Insulators C. Calculate electrical values of specific circuits vs. actual measurement D. Identify parallel and series circuits E. Record current flow through wire passing through magnetic field	Written or oral quiz A. List conductors and insulators B. Problems calculated finding voltage, amperage and resistance C. Explain basic characteristics of electricity D. Draw schematic of simple electrical circuit E. Quiz on electrical terminology
A. Lecture, using charts, or actual cutaway of battery, slides or transparencies . Identify each component B. Explain types of batteries . Dry . Wet C. Demonstrate testing a battery procedure . Immediately following activation . Troubleshooting a battery problem . specific gravity test . visual inspection . light load test . Charging procedure D. Handout sheet showing electrolytic action in a battery E. Handout sheets or copies of manufacturers' battery rating charts	A. Using handout sheet, identify components B. Physically check a battery for electrolyte and fill to proper level if necessary C. Test a battery after activation D. Test a battery which has been in service E. Hook up charger on a battery	A. Written or oral quiz identify components of a battery B. Quiz on battery terminology C. Quiz or oral explanation of procedure to check a battery . Immediately after activation . During service D. Written or oral test on testing procedure E. Written or oral test on battery terminologies F. Perform tests and service correctly

Code - 01.0301-28 AGRICULTURAL

Title - TRACTOR STARTING AND CHARGING SYSTEMS

OBJECTIVES BY UNIT	CONTENT
Unit 3 Charging System Objective 3. Identify components of the charging system, explain the operational function of each, and perform tests to obtain maximum efficiency by using proper test equipment Demonstrate the ability to service and repair charging system components.	A. D.C. charging system . Generator . types . basic purpose . components . types of circuits . "A" and "B" . periodic service required . polarizing . operation principles . testing procedures . bench tests . on-vehicle tests . types of failures . Regulators . types . cutout . voltage . current . basic purpose . components of . operation principles . periodic servicing . testing and adjusting procedures . transistorized regulators--tests and adjustments . safety precautions B. A.C. charging system . Alternator . compare with generator . types . basic principles of operation . components . advantages . safety precautions when servicing . test procedures . special tools to service . design variations

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture using charts, handout sheets and actual components or cutaway B. Using actual components, dismantle a generator C. Handout sheets showing components D. Demonstrate servicing procedures using . Volt meter . Ammeter . Growler . Turn down armature . Generator test stand E. Handout sheets showing types of regulators and their components F. Lecture, using actual components, show cleaning and adjustments G. Demonstrate, using proper test equipment, clean and adjust per manufacturers' specifications . Bench test . On vehicle H. Lecture using charts, cutaway, and actual components or complete alternator . Compare with generator . Identify components . Test output on vehicle . Test output on Bench tester . Discuss typical failures I. Demonstrate use of special required tools J. Demonstrate the procedure for adjusting and troubleshooting transistorized regulator	A. Assign a generator to each student to disassemble B. Identify generator components after disassembly C. Bench test components D. Polarize generator E. Run test of reassembled generator on generator alternator test stand F. Run test on regulator, clean and adjust and rerun test, compare with manufacturers' specifications G. Identify components of alternator H. Perform tests on alternator on vehicle I. Perform tests on alternator on Bench tester J. Dismantle alternator using special tools and testing components K. Replace faulty parts	A. Written or oral quiz, identify generator components B. Test generator on generator-alternator tester, compare output with manufacturers' specifications C. Oral or written quiz on terminologies on generator D. Oral or written quiz on regulator terminologies E. Perform actual test on regulator, clean and adjust to manufacturers' specifications F. Oral or written test on alternator terminologies G Test an alternator, record results and compare with manufacturer's specifications H Orally explain precautions required with alternators I Sketch a diagram of a typical charging circuit

Code - 01.0301-28

AGRICULTURAL

Title - TRACTOR STARTING AND CHARGING SYSTEMS

OBJECTIVES BY UNIT	CONTENT
Unit 4. Starting System Objective 4. Identify the major components of the starting systems, explain the functional operation of each component and perform tests to obtain maximum efficiency from the system by utilizing proper test equipment Demonstrate the ability to service and repair starting system components.	A. Purpose of the starting circuit B. Typical starting circuit C. Principles of operation D. Cranking Motors . Types . Switches . Drives . bendix . overrunning clutch . inertia . Switches . solenoid . magnetic switch . direct . Lubrication E. Troubleshooting starting system . Magnetic switch type . Solenoid type . Importance of battery . Effects of cold weather . Effects of high oil viscosity F. Testing comparison with manufacturers' specifications G. Check a starting system on a vehicle

EDUCATION

01.0301-28 - Code

TRACTOR STARTING AND CHARGING SYSTEMS - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Handout sheet of typical starting circuit with terminologies B. Lecture, using charts and diagrams, explain the starting circuit . Purpose . Components C. Using actual components, dismantle, test each component, reassemble and perform following tests . Armature test . Solenoid test . Field test . Brush tension . No-load test . Lock test . Resistance test D. Using a vehicle starting system, check out the complete system	A. Identify components of starting system from handout sheet B. Sketch a typical starting circuit C. Assign components to dismantle D. Test individual components E. Test complete assemblies and compare with manufacturers' specifications F. Assign a vehicle to each two students, have them perform tests to locate G. Service and repair faulty parts.	Written or Oral Quiz A. Sketch a typical starting circuit . Identify each component B. Describe tests required to completely check out a starter C. Perform a test on a vehicle

MODULE OF INSTRUCTION

Title - TRACTOR STARTING AND CHARGING SYSTEMS Code - 01.0301-28

RESOURCE MATERIALS

Books

Delco Remy Test Specifications, Division of General Motors Corp., Anderson Indiana
    DR-324 S Test Specifications - prior 1956
    DR-324 S-1 Test Specifications - 1956-1963
    DR-324 S-2 Test Specifications after 1963

Tractor Electrical Diagnosis, Ford Motor Company, Tractor and Implement Operation, Birmingham, Michigan

Facts About Storage Batteries, E.S.B. Brands, Inc., P.O. Box 6949, Cleveland, Ohio

Massey Ferguson, Inc., 12601 Southfield Road, Detroit, Michigan, Capsule #7, Electrical Systems

Bulletins

Delco Remy Service Bulletins, Division of General Motors Corp., Anderson, Indiana

Audiovisuals

Training Charts, Delco Remy, Technical Literature Section, Anderson, Indiana 46011, Charts with manuals on periodic maintenance and circuit checks DR-5221 and Service tips DR-9019

MODULE OF INSTRUCTION

Title - MILKING EQUIPMENT

Code - 01.0301-26

DESCRIPTION:

Students involved in this module will be exposed to the machinery and equipment involved with the production and handling of milk. Student will identify milking and milk handling equipment as well as laying out the several systems of milk handling. Pumps, lines and machines will be disassembled, repaired and reassembled by students. Much of the student's time will be spent in analyzing the several systems of milk handling via field trips.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Machine Milking Development	1	3
2. Milking Machines	1	6
3. Vacuum Systems	1	4
4. Electrical System	1	2
5. Milking Systems	1	3
6. Milk Hauling	1	6
	6	24

Revised June 1975

MODULE OF INSTRUCTION

Title - MILKING EQUIPMENT Code - 01.0301-26

Objectives to be obtained:

Students will be able to:

1. Outline, either in writing or orally, the major developments in the history of machine milking.
2. Correctly identify the major accoutrements (strip cup, dipping pails, disinfectants, cleaning solutions and others) of the milking process.
3. Identify the major parts of a milking machine.
4. Disassemble and reassemble a milking machine within the time allotted by the instructor.
5. Troubleshoot a "bugged" milking machine as directed by the instructor
6. Check amount of vacuum on line.
7. Troubleshoot a "bugged" vacuum line.
8. Clean vacuum lines
9. Adjust and service vacuum controller
10. Disassemble, repair and reassemble a vacuum pump.
11. Service and maintain two types of stall cocks.
12. Read wiring diagram and wire a system switch.
13. Identify several electrical components used in a modern milking maching operation such as : timer - converter.
14. Identify the various types of barns and parlors in use in the area of the school system.

MODULE OF INSTRUCTION

Title - MILKING EQUIPMENT Code - 01.0301-26

Objectives to be obtained:

15. Sketch plans utilizing the various systems of milking.

16. Compare three systems of milking equipment installation systems.

17. Identify by name the major components of the transfer pump and system.

18. Demonstrate his ability to set up a model line that will function correctly, given a vacuum pump, line and motor, sanitary trap, regulators, stall cocks, drain plugs and other necessary equipment.

19. Read a bulk tank measuring device and interpret the reading from the chart into pounds of milk.

Code - 01.0301-26

Title - MILKING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Machine Milking Developments. Objective 1 Outline, either in writing or orally, the major developments in the history of machine milking.	A. How a cow makes milk . Function of the udder, blood, hormones, etc. . The mechanics of milking B. Development of the milking machine . First patent 1818 by Anna Baldwin - pitcher pump method . Dr. Carl Gustar - Patrik DeLoral 1894 . 1918 - first really successful milking machine . 1928 - magnetic pulsing . Modern developments C. Important steps in correct machine milking . Cow placement in milking order . Cow preparation - clean udders . Use of strip cup . Attaching milker . Milking . recommended pulsatious/min . recommended inches of vacuum . recommended duration - min/cow . Stripping with machine . Removal of teat cups . Udder sanitation . Milker sanitation

EDUCATION

01.0301-26 - Code

MILKING EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture B. Slides C. Display of bulletins and pictures D. Overhead projector and overlays		A. Have the student explain in writing what physiological changes take place in the cow as a result of washing and massaging the udder and teat one minute prior to milking. B. Have each student demonstrate his ability to use the strip cup for checking each quarter prior to milking. The evaluator should make sure that a minimum of two or three streams of milk from each quarter are run through the sieve of the strip cup and checked for mastitis. C. Have the student demonstrate his ability to put a milking machine on a properly prepared milk cow as quickly and quietly as possible. D. Have the student demonstrate his ability to determine when the cow has been completely milked out by feeling and working the udder and use of the machine strip process.

OBJECTIVES BY UNIT	CONTENT
Unit 2 - Milking Machines. Objective 2 Correctly identify the major accoutrements (strip cup, dipping pails, disinfectants, cleaning solutions and others) of the milking process.	D. The importance of fast milking . Duration of the effect of oxytocin hormone . Creation of good or bad milking habits
Objective 3 Identify the major parts of a milking machine.	E. Types of milkers . Floor type . Suspended type F. Types of pulsators . Vacuum pulsators . Magnetic pulsators
Objective 4 Disassemble and reassemble a milking machine within the time allotted by the instructor.	
Objective 5 Troubleshoot a "bugged" milking machine as directed by the instructor.	

E D U C A T I O N

01.0301-26 - Code

MILKING EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
	A. A student developed display of many various kinds of solutions, ingredients, and equipment used for udder and milker sanitation would allow the student to become familiar with many of the accoutrements.	A. Have each student demonstrate his ability to use the strip cup for checking each quarter prior to milking. The evaluator should make sure that a minimum of two or three streams of milk from each quarter are run through the sieve of the strip cup and checked for mastitis.
	B. A field trip to a local dairy farm that might be milking would give the students an opportunity to see and later discuss the milking procedure practiced.	B. Have each student demonstrate his ability to put a bucket-type milking machine together and sanitize it properly in preparation for milking.
	C. Students will disassemble completely the milkers and study the parts carefully learning how you change liners in teat cups, how the pulsators work, where the critical areas are, how vacuum is carried to interior and exterior of the liners, how milk gets to the pail, how overfilling a pail effects the pulsators and other machine parts, etc.	C. Have student orally or in writing identify milking machine parts and accoutrements.
	D. Bug the machines (simulating leaky air hoses, ruptured liners, dirty pulsators, shorted magnetic connections, etc.) and have the students find and correct the malfunction. (There are a very great many lessons that can be learned in this unit that will be of invaluable help to the student that may go out troubleshooting for a milker dealership.)	D. Instructor assess students' ability to troubleshoot an inoperative milking machine.

Code - 01.0301-26

Title - MILKING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Vacuum Systems. Objective 6 Check amount of vacuum on lines. Objective 7 Troubleshoot a "bugged" vacuum line. Objective 8 Clean vacuum lines. Objective 9 Adjust and service vacuum controller. Objective 10 Disassemble, repair and reassemble a vacuum pump. Objective 11 Service and maintain two types of stall cocks.	A. Major parts . Pumps . centrifugal . piston . Sanitary traps . Vacuum controllers . Automatic drain cocks . Vacuum lines, pipes . Stall cocks B. Maintenance and servicing . Pumps . Traps . Controllers . Lines . Stall cocks

01.0301-26 - Code

MILKING EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion B. Overhead projector and overlays C. Slides D. Farm visits E. Work on shop model	A. Students will work on centrigugal pumps and piston pumps. B. Students will locate restrictions and plugs in model vacuum line set up in lab. (Use both straight line and circular type.) C. Students will properly clean and flush vacuum lines. D. Students will adjust vacuum controllers to give specified vacuums. E. Students will service and maintain vacuum controllers.	A. Instructor evaluation of student's demonstration ability to service, maintain, and troubleshoot vacuum lines and pumps.

Code - 01.0301-26

Title - MILKING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 4 - Electrical Systems. Objective 12 Read wiring diagram and wire a system switch. Objective 13 Identify several electrical components used in a modern milking machine operation such as: timer-convertor.	A. Entrance wiring B. Switch panel C. Vacuum pump motor D. Timer - convertor E. Automatic washer F. Bulk tank refrigeration units G. Miscellaneous . Receiver job probes . Cycling devices . Timers
Unit 5 - Milking Systems Objective 14 Identify the various types of barns and parlors in use in the area of the school system. Objective 15 Sketch plans utilizing the various systems of milking.	A. Methods of milking . Stanchions . Parlors . tandem . herringbone B. Determining factors . Size of herd . Amount of help available . Investment required C. Milk handling . Pail . Dumping stations . Pipelines

01.0301-26 - Code

MILKING EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion B. Overhead projector and wiring diagram overlays. C. Slides. D. Farm visits. E. Guest speaker - from dealership.	A. Farm visits to study various wiring systems as applied to milking units and observing automatic washers, refrigeration units, etc., and how they are controlled and wired. B. Troubleshoot electrical wiring to locate failure causes. An actual visit can be set up and "bugged" to simulate shorts, breaks, burned fuses, grounding, etc.	A. Written quiz reading a wiring diagram. B. Orally or in writing identify electrical components and their functions. C. Student demonstrates to the instructor his skill in troubleshooting the electrical system.
A. Field trips B. Slides C. Overhead projector and overlays	A. Visit several dairy farms, study the different lay-out and find out what the farmer would do differently were he to do it over again. (There are few farmers that wouldn't make some change.) In a stanchions set-up figure out how far the farmer travels carrying milk to bulk tank - compare it with a dumping station set-up and with a pipeline set-up. How large should the dairy be to make a change? What would each student recommend if it were his set-up?	A. Student identify milk handling equipment and parlor arrangements. B. Instructor evaluation of sketch plans for given farm situations.

Code - 01.0301-26

Title - MILKING EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 6 - Milk Hauling Objective 16 Compare three systems of milking equipment installation systems. Objective 17 Identify by name the major components of the transfer pump and system.	A. Milk transferring . Materials . glass pipe . stainless steel pipe . plastic pipe and tubing . Installation . layout, pitch, risers, cornus involved . making joints, connections . cutting and fitting . Transfer pumps . installation . sanitation . disassembly, repair and assembly . Strainers . Tubing dryers
Objective 18 Demonstrate his ability to set up a model line that will function correctly, given a vacuum pump, line and motor, sanitary trap, regulators, stall cocks, drain plugs and other necessary equipment.	B. Weighing and measuring . Total weight - weigh jars . Proportional weighing . Combination weight and flow metering C. Automation equipment . Receiving jars and probes . Automatic can fillers . Bulk tanks D. Milk storage . Cans and coolers . dry coolers . wet coolers . Bulk tanks . types . pressure . vacuum . Range in sizes . Cooling systems . self contained . remote . air cooled and water cooled units . Calibration and measuring devices . Sanitations . manual . automatic

EDUCATION

01.0301-26 - Code
MILKING EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion B. Overhead and overlays C. Slides D. Field trips E. Bulletins and pictures	A. Make some farm visits to study milk transfer and handling systems. Have students make sketch of air installation showing clearness, particularly around the bulk tank and wash tank. Have students look up code requirements regarding milk rooms. How do these sketches comply? What changes would they suggest? B. In shop have student disassemble a transfer pump and reassemble. Where are the trouble areas? How should it be repaired?	A. Written or oral identification of transfer material and pumps.
	A. With some glass pipe and fittings (if available) or with available measurements of pipe and fittings have students plan what pieces to use to fit a pipe line correctly between two or more points. (Each student could be given a different set of circumstances.) The points need not be in a straight line but offset different amounts. This would involve different elbows, etc.	A. Instructor assessment of student's model line. B. Instructor assess student's understanding of factors to consider in designing a system.

MODULE OF INSTRUCTION

Title - **MILKING EQUIPMENT** Code - **01.0301-26**

RESOURCE MATERIALS

A. Bulletins -

DeLaval

Milking Systems	SA 1423
Bulk Tanks	SA 1517
Sanitation Products	SA 1543
DeLaval 200	SA 1534 and SA 1540
Handbook on Milking	SA 1175
Vacuum Pumps	SA 1431
Transfer Units	SA 1351

MODULE OF INSTRUCTION

Title - FARM TRACTOR AND VEHICLE OPERATION Code - 01.0301-27

DESCRIPTION:

This module is designed to prepare the student to operate farm tractors and vehicles safely and efficiently. Theory of operation will be included to the extent necessary to make the adjustments and repairs needed for safe and efficient operation under farm conditions. Most of the time will involve development of skills needed for operation.

Preventive maintenance and its importance will also be stressed in this module. Emphasis will be on spending a little time before operation to save countless hours of lost time later.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Tractor and vehicle operation safety	2	2
2. Performing maintenance and pre-operation jobs	1	6
3. Operating tractors and vehicles	2	17
	5	25

Revised August 1975

MODULE OF INSTRUCTION

Title - FARM TRACTOR AND VEHICLE OPERATION Code - 01.0301-27

OBJECTIVES to be obtained:

Students will develop and demonstrate the effective ability to:

1. Correctly list the hazardous occupations and highway operations laws that apply to farm tractors and vehicles in use, on and off the highway.
2. Demonstrate, to the instructor's satisfaction, ability to use an owner's manual to determine correct procedure to follow in maintaining and performing recommended repair of farm tractors and vehicles.
3. Correctly perform recommended maintenance jobs on farm tractors and vehicles using the operator's manual as a guide.
4. Perform, to the instructor's satisfaction, recommended repairs on tractors and vehicles, which can be made with basic tools using the operator's manual for reference.
5. Demonstrate, to the instructor's satisfaction, ability to operate modern farm tractors and vehicles in a safe and efficient manner under farm conditions.

Code - 01.0301-27

AGRICULTURAL

Title - FARM TRACTOR AND VEHICLE OPERATION

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Tractor and vehicle operation safety Objective 1 Correctly list the hazardous occupations and highway operations laws that apply to farm tractors and vehicles in use on and off the highway	A. Hazardous occupation laws - latest edition B. Highway operations laws affecting farm tractors and vehicles (Rules of Road from Bureau of Motor Vehicles) C. Safety rules to follow when operating farm tractors and vehicles
Unit 2 - Performing maintenance and preparation jobs Objective 2 Demonstrate, to the instructor's satisfaction, ability to use an owner's manual to determine correct procedure to follow in maintaining and performing recommended repair of farm tractors and vehicles	A. Owner-operator's manual (each student needs one for tractor(s) used during module) . Material in the manual . Using the manual for maintenance . Using the manual for troubleshooting
Objective 3 Correctly perform recommended maintenance jobs on farm tractors and vehicles using the operator's manual as a guide	A. Maintaining farm tractors and vehicles . Following recommended times from operator's manual . Performing jobs safely . Using tools properly . Carrying out maintenance jobs
Objective 4 Perform to the instructor's satisfaction, recommended repairs on farm tractors and vehicles, which can be made with basic tools using the operator's manual for reference	A. Determining types of repairs to be made . Skill of operator . Time required . Tools available . Manufacturer's recommendations B. Performing repairs safely C. Using tools properly D. Repairing farm tractors and vehicles

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture-discussion to present facts B. Resource personnel such as: . extension agent specializing in farm law . law enforcement C. Displays . models showing safety features . charts D. Refer to National Rural Safety Council materials and Safe Tractor Operation from Michigan, Special Paper #8	A. Take note of new information B. Study resource material . Rules of the Road manual . hazardous occupations law C. Question resource personnel D. Help set up displays	A. Written test B. Observe student's actions throughout module to determine their attitude toward and use of safety precautions and operation rules
A. Lecture-discussion B. Demonstration using the manual to perform maintenance and repair jobs on the machine C. Student practice	A. Take note of new information B. Study operator's manual C. Assist in performing jobs during demonstrations D. Practice using manual to perform recommended operations	A. Evaluate students' ability to get correct information from operator's manual
A. Demonstration B. Student practice C. Field trip(s) . farm . machinery dealership	A. Students will perform recommended maintenance jobs on tractors and vehicles at the school, a farm, or a machinery dealership	A. Evaluate students' ability to perform maintenance jobs
A. Lecture-discussion as needed by students B. Demonstrations C. Student practice D. Field trip(s)	A. Assist in demonstrations B. Practice repairing farm tractors and vehicles at the school, a farm, or a machinery dealership	A. Evaluate students' ability to repair a tractor or vehicle in need of repair

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Operating farm tractors and vehicles Objective 5 Demonstrate, to the instructor's satisfaction, ability to operate modern farm tractors and vehicles in a safe and efficient manner under farm conditions	A. Operating farm tractors and vehicles . Identifying parts of tractors and vehicles . Pre-operating procedures . Starting and stopping the tractor engine . Controlling movement . Hitching and unhitching equipment . Operating under field conditions . Operating under highway conditions . Maneuvering attached equipment

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Lecture-discussion B. Filmstrip, slides and/or movies C. Field trip(s) D. Student practice	A. Study reference material B. Practice operating machinery to master skills required	A. Continuously evaluate students as they operate tractors (a checksheet would be useful)

TRACTOR OPERATION, SAFETY, AND MAINTENANCE

You are responsible to learn the location, importance, and use of each of the following as it applies to the school tractor:

1. oil pressure tellite
2. fuel gauge
3. horn
4. speedometer-techometer
5. fuse housing
6. starter button
7. gear shift
8. hi-lo shift
9. clutch
10. pto shift
11. alternator tellite
12. temperature gauge
13. throttle lever
14. light switches
15. choke control
16. key switch
17. position control lever
18. draft control
19. brake lock
20. brake pedals
21. brake pedal latch
22. hi lift control levels
23. foot throttle control
24. seat adjustment
25. gas fill cap
26. water fill cap
27. oil fill cap
28. oil dip stick
29. gas sediment bulb
30. hydraulic isolating valve
31. three-point hitch levers
32. pto shaft
33. air cleaner

Name ______________________________

MODULE OF INSTRUCTION

Title - Farm Tractor and Vehicle Operation　　　　Code - 01.0301-27

RESOURCE MATERIALS

Books:
1. Appropriate operator's manuals for tractors and vehicles.
2. Safe Tractor Operation - Special paper #8, Rural Manpower Center, Michigan State University.
3. Rules of the Road - Bureau of Motor Vehicles.

Bulletins:
1. Hazardous Occupations Laws - N.Y.S. Labor Department

Periodicals:
1. Farm Machinery periodicals should be helpful.
2. Rural Safety - National Safety Council

Audiovisuals: Safety charts from N.Y.S. Rural Safety Council and Farm Equipment Companies.

Safe Tractor Operation Kit - Ford Motor Company

Tractor Operation • Daily Care - A.A.S.A.E.+ V.A., Athens, Georgia

MODULE OF INSTRUCTION

Title - CONSTRUCTION AND IMPROVEMENT OF AGRICULTURAL STRUCTURES Code - 01.0302-02

DESCRIPTION:

This module is concerned with the actual construction or improvement of an agricultural structure. Given a site, a plan and a bill of materials, the student will perform the actual construction, starting with a foundation and completing with the application of an exterior preservative.

MAJOR DIVISIONS OR UNIT OF CONTENT	Time Allocations Class	Other
1. Review construction terms, building plan, bill of materials, and tools needed for construction	2	
2. The construction of a pier foundation		6
3. The construction of the floor		4
4. The construction of the roof	1½	5
5. The construction of the exterior walls	1	8
6. The painting of the structure	½	2
	5	25

Revised June, 1974

MODULE OF INSTRUCTION

Title - CONSTRUCTION AND IMPROVEMENT OF AGRICULTURAL STRUCTURES

Code - 01.0302-02

OBJECTIVES to be obtained:

The student will be able to:

1. Define and identify, from a given list, the common construction terms.
2. Demonstrate the ability to accurately interpret the set of plans and the bill of materials so that the structure will be constructed as planned.
3. Develop a list of tools he thinks will be needed for the construction.
4. Determine the depth of excavation at each pier location by using a measuring tool.
5. Determine the amount of concrete and the type of mixture needed for the footings. (If not given in the bill of materials)
6. Write an order using the proper terms so that a ready mix dealer could understand the order.
7. Place the concrete into each footing with accuracy for levelness at the top of each footing.
8. Lay concrete blocks correctly at each of the piers.
9. Construct the sills, headers, floor joist and flooring with the aid of carpenter's tools so that the floor construction meets the specifications in the plan.
10. Mark the stud placement on the sole and top plate according to the plan.
11. Nail the studs, erect, plumb, and brace the exterior walls by using carpenter's tools so that the exterior walls are constructed according to the plan.
12. Install the double top plate, nail the corners and apply the sheathing using the plan as the guide.
13. Lay out, cut and assemble trussed rafters according to the plan for roof construction.
14. Use carpenter's tools to mark the top plate for rafter placement; place the rafters in position, anchor, plumb and brace the rafters according to the plan.

OBJECTIVES to be obtained:

(continued)

15. Apply roof sheathing and roofing materials on the rafters correctly.
16. Mix the exterior paint according to directions on the can.
17. Apply paint to the structure so that qualities of appearance and durability are obtained economically.
18. Clean and store paint and painting equipment to the satisfaction of the instructor.

Code - 01.0302-02

Title - CONSTRUCTION AND IMPROVEMENT OF AGRICULTURAL STRUCTURES

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Review construction terms, building plan, bill of materials, and tools needed for construction. Objective #1 Define and identify, from a given list, the common construction terms.	A. Construction terms (see book ref.#7-p.383-398 . Anchor . Base . Batter board . Bearing wall . Bevel . Bridging . Build up timber . Casing . Cornice . Direct nailing (face nailing) . Exterior wall . Fascia . Flashing . Footing . Foundation . Framing . Furring . Girder . Gambrel roof . Header . Heel of a rafter . Jamb . Joist . Ledger strip . Lintel . Molding . Pier . Pitch . Plan . Plate (top & sole) . Preservative . Purlin . Rafter . Rise . Roof hip . Roofing . Run . Sash . Sheathing . Sill . Span . Studding . Sub floor . Termite shield . Toe nailing . Others
Objective #2 Demonstrate the ability to accurately interpret the set of plans and the bill of materials so that the structure will be constructed as planned.	A. Distribute plans - one per boy; not less than one per group B. Distribute bill of materials - one per boy; no less than one per group.

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Ditto handout containing terms you want the student to study. B. Discussion C. Overhead overlays - select only appropriate overlays. See audio-visual #1)	A. Study on his own the terms necessary to construct a building. B. Study with others C. Be able to define at least 20 out of a possible 25.	A. Give the student a list of 25 construction terms for him to define. Performance grade should be 20 out of 25. B. After the structure has been completed, have students identify 20 out of 25 terms.
A. Class discussion B. Question-answer session	A. The student must know: . The outside dimensions of the building . Floor joist spacing . Stud spacing . Rafter spacing . Pitch of the rafters . Size of the rough openings . How to match the items in the bill of materials with the plan . Length of the plates . Length of the studding . Others as determined by the teacher.	A. The teacher should develop ten or more questions concerning the interpretations of the plan. He could make up a quiz from this list. Performance should be at least 70%. Example: The distance between the rafters is _______. The length of the sole plate on the side of the building is _______________.

OBJECTIVES BY UNIT	CONTENT
Objective #3 Develop a list of tools he thinks will be needed for the construction.	A. Tool identification chart (see audio #2) . One per student B. Make available the references so that the student might correlate readings and diagrams with tools.
Unit 2- The construction of a pier foundation Objective #4 Determine the depth of excavation at each pier location by using a measuring tool.	A. Construction Plans . Thickness of footing . Depth for frost level . Know placement of concrete blocks so outside measurements of footing can be determined. . Number of concrete blocks per pier . size of block (see book #9 p 138-142) . type of block . mortar thickness (See book #5 p. 73-103) book #7 p. 10 book #4 p. 21-22
Objective #5 Determine the amount of concrete and the type of mixture needed for the footings. (If not given in the bill of materials)	A. Amount of concrete needed . Formula 1 Cu. Yd. equals 27 Cu. Ft. B. Number of bags of cement to be used per Cu.Yd. C. Number of gallons of water to use per bag of cement. D. Order 5-10% extra E. Air-entrained cement F. Adding extra water at site (See book #6 p 108-109) book #2 p 36 - 40 bulletin #1 p 5

E D U C A T I O N 01.0302-02 - Code

CONSTRUCTION AND IMPROVEMENT OF AGRICULTURAL STRUCTURES - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion B. Question time C. Independent study	A. The student will prepare a list of tools he thinks will be needed for construction and return to the teacher. B. Each group of students working on one building will take account of all of the tools used during the construction.	A. The teacher should compare each students list at the beginning and the end of construction. From this the teacher can evaluate the knowledge of tool usage through construction.
A. Field trip to site. B. Demonstration at one pier. C. Discussion.	A. Use line level to determine levelness of string. B. Measure the depth to which the footing will be placed. C. Know the thickness of the footing. D. Dig a hole at each pier location to the proper size for the footing.	A. Check the measurement of the students figures against yours.
A. Independent study. B. Problem solving. C. Mimeo handout on examples and computation.	A. Compute concrete needed for site B. Know the mixture being used (See book #2 p 61-67) book #6 p 108-109 bulletin#1 p 50	A. The teacher should check the figures of the student to see if they agree with his.

OBJECTIVES BY UNIT	CONTENT
Objective #6 Write an order using the proper terms so that a ready mix dealer could understand the order.	A. Contact local ready mix dealer to see the way he likes to see an order written. B. Give students an example of correct techniques. (See bulletin #3)
Objective #7 Place the concrete into each footing with accuracy for levelness at the top of each footing.	A. Place concrete in hole . Pushing, shoveling, flowing B. Spade as being placed C. Disadvantages of overworking concrete . Fine materials including paste will tend to work to the top resulting in non-homogenous mixture of unequal density. D. Spade walls to remove air pockets. E. Lightly rod concrete throughout. (See book #2 p 82-85) bulletin #1 p 14-15
Objective #8 Lay concrete blocks correctly at each of the piers.	A. Mixing mortar B. Placing mortar C. Laying blocks D. Anchoring bolts (See book #5 p 12-13) p 176-182 bulletin #2 p 3-5 complete step by step procedure

CONSTRUCTION AND IMPROVEMENT OF AGRICULTURAL STRUCTURES

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Class discussion B. Problem solving C. Movie (See visual #4)	A. Write an order for the concrete needed for the footing at your site. B. One student will actually make the order with the ready mix dealer.	A. Check over the order forms for completeness. B. Make sure the actual order is correct before calling the dealer.
A. Field trip to site. B. Demonstration at pier. C. Discussion at site.	A. Place the concrete in the excavation for the footing. B. Check all footings to be sure they are level with each other. . Measurement from string . Check levelness of string C. Check the distance between the line and the top of the footings to be sure the distance is correct for the block installation.	A. Check the students measurements to be sure they are correct.
A. Independent study. B. Field trip to site. C. Demonstration at pier. D. Discussion at site E. Movie (see audio #3)	A. The student will select tools necessary to complete piers. B. The student will mix the mortar. C. The student will lay blocks. D. The student will place the anchor bolts in the right place. (See Bul. #2 p 3-5) Book#5 p 176-182 p 12-13	A. Check each pier to see if it is plumb. B. Check each pier to see if it is level C. Check each corner to see if it is square with the building plan

OBJECTIVES BY UNIT	CONTENT
Unit 3 - The construction of the floor Objective #9 Construct the sills, headers, floor joist and flooring with the aid of carpenter's tools so that the floor construction meets the specifications in the plan.	A. Sills, headers, floor joist . Length to cut . Number needed . Size nails to use . Nailing technique . Spacing of joist . Selection of materials from bill of materials B. Safe operation of power tools (saw mainly) . Operating condition of the tool . Workers clothing . Safe working area . Safety guards in place - glasses (See Book #6 p 55-57) Book #7 p 62-76 Book #1 p 17-23 p 41-50 p 64-69
Unit 4 - The construction of the roof Objective #10 Mark the stud placement on the sole and top plate according to the plan.	A. Follow plans in interpreting the stud spacing (See Book # 1 p 85-90) Book #6 p 58-59 Book #4 p 47-52
Objective #11 Nail the studs, erect, plumb, and brace the exterior walls by using carpenter's tools so that the exterior walls are constructed according to the plan.	A. Studs . Cut to correct length . Quality of the cut . Nailing to the plate . Use of level . Bracing for stability (See Book #1 p 85-90) Book #7 p 78-94

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Independent study of plans B. Discussion at site C. Construction at site.	A. Anchor sills B. Cut and nail headers C. Space joist and nail D. Cut, nail and lay flooring E. Display safe operating techniques of power equipment (See Book #7 p 62-76) Book #6 p 55-57	A. On site evaluation . Nailing procedures . Joist spacing . Cutting accuracy . Safe use of power tools
A. Independent study of plans. B. Discussion at site. C. Demonstration at site.	A. Lay out stud spacing on the sole and top plates according to the plans. (See Book #6 p 58-59)	A. Check the spacing to see that it follows the plan.
A Demonstration at site. B. Discussion at site.	A. Student will cut materials B. Student will nail studs to plates C. Student will erect exterior walls D. Student will plumb and brace walls E. Student will select proper materials from bill of materials.	A. Check on the using of the level by making sure the corners are plumb. B. Check to make sure the bracing is stable. C. Check on the nailing techniques.

OBJECTIVES BY UNIT	CONTENT
Objective #12 Install the double top plate, nail the corners and apply the sheathing using the plan as the guide.	A. Tie corners together by overlapping the top plate. B. Sheathing . Select proper material . Cut to fit studs properly - center . Use good nailing techniques (See Book #1 p 92-96) Book #4 p 48
Unit 5 - The construction of the exterior walls Objective #13 Lay out, cut and assemble trussed rafters according to the plan for roof construction.	A. Laying out rafters . Marking off by use of steel square B. Rafter length . $A^2 + B^2 = C^2$ (See Book #3 p 186-191) Book #7 p 104-108 Book #4 p 63-74 Book #6 p 79-80 Book #1 p 111 and 116
Objective #14 Use carpenter's tools to mark the top plate for rafter placement; place the rafters in position, anchor, plumb and brace the rafters according to the plan.	A. Make sure center to center measurement is according to plan. B. Methods of anchoring . Nailing . Use of metal hangers C. Nailing techniques for sheathing . Spacing of nails (See Book #7 p 108-112)

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstration on site. B. Discussion at site.	A. Students will cut and nail double plate. B. Students will nail corners. C. Students will select proper materials for sheathing. D. Students will cut and nail sheathing.	A. On site evaluation .Nailing techniques .Spacing of sheathing on studs .Cutting procedures . Quality of cuts
A. Demonstration on laying out a rafter. B. Demonstration on assembling C. Independent study D. Discussion on site.	A. Students lay out rafters. B. Students assemble trussed rafters. C. Students select rafter material from hill of materials and cut to proper length and angle.	A. Check the angle of the plumb cut. B. Check the length of each rafter. C. Check the nailing technique for durability.
A. Discussion at site. B. Demonstration at site.	A. Students carefully mark out correct spacing on the top plates. B. Use tri-square correctly. C. Students place rafters one at a time and anchor. D. Students brace rafters as they go along.	A. Check spacing to see if it meets the plan specifications. B. Check rafters to see if they are plumb. C. Check to see if bracing is stable.

OBJECTIVES BY UNIT	CONTENT
Objective #15 Apply roof sheathing and roofing materials on the rafters correctly.	A. Sheathing . Proper measurement . Proper cutting techniques . Proper spacing on the rafter . Proper nailing techniques B. Roofing materials . Directions on material . starting procedure . nailing procedure . ridge finishing (See Book #7 p 169-206) Book #6 p 81-85 Book #4 p 71-74
Unit 6 - The painting of the structure Objective #16 Mix the exterior paint according to directions on the can.	A. Directions on can
Objective #17 Apply paint to the structure so that qualities of appearance and durability are obtained economically.	A. Size brushes B. Painting procedures C. Time to paint (See Book #3 p 202) 205-206 208
Objective #18 Clean and store paint and painting equipment to the satisfaction of the instructor.	A. Cleaning techniques . Proper solvent . Completeness of removal of paint B. Storing paint so that quality of paint is maintained. (See Book #3 p 205)

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CONSTRUCTION AND IMPROVEMENT OF AGRICULTURAL STRUCTURES - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstration on site. B. Class discussion.	A. Students nail all roof boards in place. B. Students select proper materials. C. Students properly start the first course of roofing. D. Students properly nail roofing. E. Students properly finish roofing with the ridge layer.	A. Check nailing quality B. Check sawing quality C. Check spacing of rafters in relation to sheathing. D. Check horizontal line of roofing material. E. Check vertical lines of roofing materials.
A. Discussion at mixing.	A. Students mix paint according to the directions on the can.	A. Check to see if directions were followed.
A. Lecture B. Class discussion C. Demonstration	A. Students apply paint to the structure so that appearance, durability and economics are shown in the job.	A. Check on sloppiness of the painter. B. Check on speed of the painter. C. Check on the quality of the paint job.
A. Demonstration of cleaning paint equipment.	A. Student will clean his brush properly. B. Student will store paint properly.	A. Check cleanliness of equipment. B. Check tightness of can cover.

MODULE OF INSTRUCTION

Title - CONSTRUCTION AND IMPROVEMENT OF AGRICULTURAL STRUCTURES   Code - 01.0302-02

RESOURCE MATERIALS

Books: Jones, Raymond P., Framing, Sheathing and Insulation. Albany, Delmar Publishers, 1964 - 228 pps.

Portland Cement Association, Concrete Technology. Albany, Delmar Publishers, 1965 - 131 pps.

Phipps, Lloyd J., Mechanics in Agriculture. Danville, The Interstate Printers and Publishers, 1967 - 808 pps.

Lytle, Esmay, and Muehling, Farm Builder's Handbook. Farmington, Michigan. Structures Publishing Co., 1969 - 206 pps.

Dalzell and Townsend, Concrete Block Construction. Chicago, American Technical Society, 9th Printing, 1966 - 216 ppgs.

Foss, Edward W., Construction and Maintenance for Farm and Home. New York - John Wiley and Sons, Publishers, 1969 - 373 pps.

Mix, Floyd M., Practical Carpentry. Homewood, Ill. The Goodheart-Willcox Co., Inc. Publishers, 1963 - 448 pps.
(There is a newer edition of this book)

Bulletins:

Use of Concrete on the Farm #2203 USDA 1965
Recommended Practices for Laying Concrete Block, Portland Cement Assoc.
Ready Mixed Concrete for the Farm, Portland Cement Assoc.
Building Better Farm Homes with Concrete, Portland Cement Assoc.

Audiovisuals:

Overhead Transparencies, 3M, Ed. Services, Box 3100, St. Paul, Minn. 55101
Vocational No. 10, House Framing #1
Vocational No. 11, House Framing #2
Vocational No. 12, Roof Framing
Vocational No. 21, Carpentry, Interior Trim
Vocational No. 22, Carpentry, Exterior Trim

Tool Chart, Benson Publishers, Box 445, Benson, North Carolina

ABC's of Concrete Masonry Construction, 10 min. movie, Iowa State Univ. Visual Instructional Services

MODULE OF INSTRUCTION

Title - CONSTRUCTION AND IMPROVEMENT OF AGRICULTURAL STRUCTURES Code - 01.0302-02

RESOURCE MATERIALS

Audiovisuals (continued)

Quality Ready Mixed Concrete, 31½ min. movie, Portland Cement Assoc.

Suggested Plans -

Agr. Engineering Extension Bulletin 851-0
Description and Price List of Plans for Cabins, Campground Shelters, Greenhouses, Recreational Facilities, Storage Sheds, and Misc. Items
Riley - Robb Hall, Cornell University, Ithaca, N.Y. 14850

Agr. Engineering Extension Bulletin 851-M
Description and Price List of Plans for Farm Shops, Machinery Storages, Garages and Utility Buildings
Same address as above

MODULE OF INSTRUCTION

Title - SHOP MANAGEMENT AND EQUIPMENT UTILIZATION Code - 01.0305-01

DESCRIPTION:

This module endeavors to orient the students to the pattern that they will follow throughout the year. If this is well done, the interest of the student is aroused and motivated to become all he is capable of being. He will be introduced to the safe and proper use of power and hand tools in the shop. He will also learn to properly care for and maintain these tools as well as their proper identity. This will include proper storage, accounting and maintenance of tools, supplies and materials, parts and other pieces of shop equipment.

The shop management taught can aid in starting good work habits and provide a basis for using the discipline of work as a part of a group without interference from others and without interfering with the progress of others.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Organizing and maintaining the shop	2	3
2. Shop safety	1	3
3. Tools and equipment	3	5
4. Materials and supplies	2	4
5. Work routine and discipline	2	5
	10	20

Revised June, 1974

MODULE OF INSTRUCTION

Title - SHOP MANAGEMENT AND EQUIPMENT UTILIZATION Code - 01.0305-01

OBJECTIVES to be obtained:

The student will be able to:

1. Record notes about shop layout, instruction, and location of equipment and supplies.

2. Verbally state the code of conduct required of students in the shop situation.

3. Record notes and bring supplies with regard to clothing, notebook, and duties in the shop.

4. Demonstrate ability to perform assigned shop duty as outlined by the instructor.

5. Explain the term shop safety and relate any incident that you may have been acquainted with.

6. State the rules of safety for the shop, tools and equipment.

7. Replace any tool in the shop to its proper location.

8. Identify each tool used in the shop and describe a correct use.

9. Inspect and operate the equipment used in the mechanics shop.

10. Identify and properly store the various materials and supplies used in the shop.

11. Demonstrate the competencies and skills necessary to successfully perform shop assignments following recognized shop procedures in a manner which exhibits personal confidence and promotes trustworthiness.

01.0305-01

Title - SHOP MANAGEMENT AND EQUIPMENT UTILIZATION

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Organizing and maintaining the shop Objective 1 Record notes about shop layout, instruction, and location of equipment and supplies	A. Orientation . Call group to order in classroom . introduce self as instructor . write name on chalkboard for correct spelling . use temporary list (pre-registration) for roll call of students . Scope of the course . describe course . indicate trade area covered . distribute brochures of course . identify successful individuals in this field of work . Shop tour . identify various areas of shop . briefly describe use of the various equipment

EDUCATION

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01.0305-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Through a well-planned orientation procedure, the instructor can explain his program to the students and thus "sell" his course.	A. Start developing a notebook from materials and information provided by the instructor.	A. Fill out a questionnaire which requests the name of the instructor, a description of the course and a diagram of the shop area with location of major equipment.
B. This is a "get-acquainted" period so the instructor gets to know the students and the students get to know the instructor.	B. Include one or two pages of regular note paper on which notes are made of information that the instructor does not include in handouts.	
C. Give a brief statement outlining the trade area which is involved with the program of instruction.	C. Make a sketch of the shop and identify the various areas in which he will be working.	
D. Name some of the very successful individuals in the field of your course, former students, or others before your time that students can relate to as future persons.	D. List the names of those people that are identified by the instructor as successful in the occupational field of study.	

01.0305-01

Title - SHOP MANAGEMENT AND EQUIPMENT UTILIZATION

OBJECTIVES BY UNIT	CONTENT
Objective 2 Verbally state the code of conduct required of students in the shop situation. Objective 3 Record notes and bring supplies with regard to clothing, notebook, and duties in the shop.	B. Shop conduct . Rules in regard to the following: . horseplay . loud talking . tardiness . shouting . loafing . gum chewing . attendance . Operation of equipment only after given proper instructions. C. Procedures . Type of work clothes . Notebook to be maintained . Briefly mention shop duties D. Other routines . Recording absence and tardiness . Class dismissal . Daily work assignments . Student progress (marking)

EDUCATION

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01.0305-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
E. At the close of this introductory presentation, the instructor should take time to tour the shop and briefly identify equipment, etc., that will possibly motivate some students to set a goal. F. Students have a right to know exactly what is expected of them. You, as the instructor, must decide the conduct that will be acceptable; explain this to them and enforce your rules and regulations. G. Discuss the type of clothing and the method of obtaining and care of such for your shop. H. Show the notebook (use a former students) that is to be maintained by the student. I. Explain school policy in relation to marking, absences, dismissal, etc., using your Teacher's Handbook.	E. Review the information provided by the instructor and become familiar with the rules of conduct he is expected to follow. F. Make arrangements for obtaining the necessary work clothes, notebook etc., that will be needed for the program. G. Report any lack of understanding to the instructor immediately for his help.	B. Verbally state the rules of conduct to the instructor when asked. C. Record the provision of those items required of the student in the class register or his personal folder.

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01.0305-01

OBJECTIVES BY UNIT	CONTENT
Objective 4 Demonstrate ability to perform assigned shop duty as outlined by the instructor.	A. Student personnel duties. . Shop superintendent . Assistant superintendent . Tool foreman . Tool clerk . Bench foreman . Maintenance man . Welding supervisor . Materials supervisor . Safety man . Machine foreman . Jack foreman . Sweepers . Substitutes B. Housekeeping in the shop. . Neatness reference manuals shop furniture safety cans fire extinguishers storage room bulletin board C. Cleanliness. . Shop clean-up . Wash-up

EDUCATION

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01.0305-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. It is absolutely necessary and desirable that an instructor develop and operate a student personnel system. The purpose of such a system is to give students an opportunity to experience responsibility, and to assist the instructor in maintaining a clean and orderly shop.	A. Study the list of duties that will be the students' responsibility and check with the instructor for any further clarification of the duty assigned if necessary.	A. Check the performance of the student during the period of assignment of his responsibilities and record the degree of proficiency in class register or personnel folder.
B. All students should be given the experience of holding all positions included in the personnel system. Do not reserve such positions as shop superintendent for the most capable students, rotate jobs every two weeks and make the job assignments meaningful.	B. Upon rotation at the end of a two week period recheck the new duty assigned and become familiar with the responsibilities.	
C. Examples of duties and method of assignment or rotation are included at the conclusion of this module.	C. Observe demonstrations and listen to instructions given by the instructor of how the various jobs or duties are to be carried out. —— Ask Questions ——	
D. Housekeeping is a necessary chore and it will pay off in fewer discipline problems, fewer accidents, and reduce fatigue for you.	D. Become a proficient worker and endeavor to do your job just a little better each time you repeat a particular task.	
E. Reference materials are hard to come by and should be arranged for your students accessibility and usefulness.	E. Keep your work area and tools clean and then clean yourself before leaving the shop.	

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01.0305-01

OBJECTIVES BY UNIT	CONTENT
Unit 2 - Shop Safety Objective 5 Explain the term shop safety and relate any incident that you may have been acquainted with.	A. History. . The uncovered era . The poster program . The bird-cage era . The education program B. Attitudes and knowledge. . Living safely . Thinking safely . Working safely

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
F. The day of the careless worker has gone for industry today is looking for trained workers to meet the modern trend toward a good economy. —— A good mechanic is a clean mechanic ——		
A. The list of suggested ways of teaching safety: . Detail the history of safety as outlined in the publication "School Shop Management" available from the State Education Department, Albany. . Appoint a student safety committee . Make a shop safety survey . Discuss safety hazards . List power tool precautions . Explain safety rules for all equipment . Use safety tests . Discuss fire drill procedure	A. Review all the information that is available on safety and obtain any article, etc., that you come across for your use in class discussions about safety. B. Be a participant where safety is concerned.	A. Student should write a description of safety in his own words and explain any accidents or unsafe acts he has been acquainted with by experience.

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01-0305-01

OBJECTIVES BY UNIT	CONTENT
Objective 6 State the rules of safety for the shop, tool and equipment.	A. Procedures. . Proper work clothing . Rules for use of hand tools . Rules for power tools . Student safety committees . Daily safety check sheet . Shop safety contest
Unit 3 - Tools and equipment Objective 7 Replace any tool used in the shop and describe a correct use.	A. .Prevention of tool losses . Method of control . silhouette tool boards . Properly arranged cabinets . self-counting racks . individual assigned tool chests . tool rooms with clerk

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. What you as the instructor do is often more important than what you say. · Set the example - never shorten and break your rules set forth. · Be alert - stay in the shop, and when necessary to leave, take the proper precautions. · Know school policy find out the regulations, memorize them and do the right thing quickly.	A. Learn the location of all safety equipment, supplies, etc., that is within the shop. B. Support every effort made in regard to safety whether you are just a member of the class, on the safety committee, or assigned the safety man's responsibility.	A. Each student should be able to state a rule of safety orally whenever asked throughout the duration of the shop program.
A. Most instructors with an overall shop consciousness have less tool and equipment difficulty. Such instructors have trained themselves to watch for misuse of tools. —— Neglect of the little problems creates the big problem —— B. The experienced instructor can testify that tools are not lost when an effective tool checking plan is rigidly enforced and students are given to understand that the loss of tools will not be tolerated.	A. Every student must assist in accounting for the tools in the shop by returning any tool he uses or finds loose on the benches or equipment and floor. B. The student should become very familiar with the method of storage and/or location system.	A. Performance tests can be used for checking the student's ability to locate or replace tools by giving him a group to replace or a list of tools to use.

OBJECTIVES BY UNIT	CONTENT
Objective 8 Identify each tool used in the shop and describe a correct use.	A. Tool use, care and value. . Tool identification . various methods of learning the identity of tools . proper use of tools . Storages of tools . cleaned . repaired . Value of tools . inventory . cost B. Shop equipment . Arrangement . planning . work space . accident prevention

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01-0305-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Tools should be asked for by the proper name and size. Similar tools might be grouped together. Students will have to learn to ask for the proper tool.	A. The student should observe and/or study whatever method the instructor uses for teaching the identification of tools.	A. Test the student by placing a group of at least 20 tools to be used by the student, on the bench areas and have each one write the name of the tools according to the number given the tool.
B. There are many useful materials available for teaching identification of tools. These are the picture cards from Interstate Publishers, Manual With a Picture section from the California State Polytechnic College, FOS General with Chapter 1 Shop Tools from John Deere Company.	B. Out of class he may obtain catalogs or ask mechanics the various tool names that he sees being used.	
C. Proper use of tools may be enhanced greatly by a list of shop tool rules and by use of booklets and movies, such as the ABC's of Handtools from the General Motors Corporation, Detroit, Michigan.	C. He should strive not to be a "Primitive Pete" of Walt Disney fame.	
D. Power tool operation and use booklets are available from the Sears, Roebuck, & Company.		

OBJECTIVES BY UNIT	CONTENT
Objective 9 Inspect and operate the equipment used in the mechanics shop.	A. Maintenance of equipment . Lubrication . Testing . Safety . Daily inspection . Operating . Cleaning, inspecting and storing

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Students can be assigned the task of routine maintenance, you the instructor, cannot assign away the responsibility which is yours.	A. Study the manufacturer's manual provided, perform the maintenance of the item of equipment assigned.	A. Check the students work after he has performed the maintenance assignment and record the degree of proficiency in class register or personnel folder.
B. Periodically, at no more than one month intervals, the instructors should personally inspect all equipment in the shop for those items listed under content.	B. Be alert to any malfunction or unsafe piece of equipment during operation, inspection or cleaning.	
C Manufacturer's manuals should be kept on file for all equipment and students assigned the responsibility of checking these to be able to perform the require maintenance.		

AGRICULTURAL

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01.0305-01

OBJECTIVES BY UNIT	**CONTENT**
Unit 4 - Materials and supplies Objective 10 To identify and properly store the various materials and supplies used in the shop.	A. Management control. . Supplies . selection . cost . storage . Identification . trade name . inventory

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01.0305-01

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. An adequate supply of materials for use in the shop is highly desirable for efficient teaching. These materials should be available to the student in limited quantities in such a manner that they can complete their assignments with a minimum of supervision. B. The student should be taught the proper name or identification of supply items and materials. This can be done with materials obtained from the sources listed previously for tools.	A. Students will be using materials and supplies so they should learn to select the items, cost price them, and store in the place provided. B. Many items the trade will have to be learned and especially for inventory purposes.	A. Many supply and/or material items can be identified and test the students with a similar test as that used for tools listed previously.

Title - SHOP MANAGEMENT AND EQUIPMENT UTILIZATION

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Work routines and discipline Objective 11 The student will demonstrate competencies and skills necessary to successfully perform shop assignments following recognized shop procedures in a manner which exhibits personal confidence and promotes trustworthiness.	A. Habit . Prepare to do the work . involves customer relations . Start the work . shows reputation of organization . Obtain repair parts . includes technical knowledge . Assemble the project . proceed in a workman like manner . stress manipulative skills . Clean-up . work completed B. Purpose of discipline . Individual's time profitable . Study progress C. Rules and regulations . Need . safety . orderliness . conduct D. Student interest . Course of study and projects . gives value

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. The student must be made aware of the value of good work habits. He must realize that only he can develop these habits in himself.	A. The student should list the points set down under the content for this unit and strive to follow this method in every job he does.	A. A check of the students' performance on a job can be evaluated best by personal observation of the instructor compared with the points listed under content.
B. The work habits necessary for the individual shop or occupational area will have to be considered carefully by you the instructor. It is necessary for you to teach and remind the students of these desired habits.	B. Through continued practice they will automatically do this and will become a dependable workman, sure of his ability, and more valuable to his future employer.	B. Evaluation of the students adjustment to his new way of life in the shop can only be determined by how he functions with other students and the instructor.
C. An instructor can evaluate his own teaching in terms of developing good work habits and set a high standard for his students in an effort to have them acquire these desirable habits.	C. The student will have to develop some self-discipline during his experience in the shop situation.	C. The degree of which should be recorded in the class register or his personnel folder.
D. It is apparent that each and every job can be broken down to the five areas listed under content.	D. The student will be making changes and adjustments as he performs the various tasks assigned especially where he is allowed to move about and be on his own.	
E. Discipline, in the meaning of control or obedience to given standards, is important to all shop or class groups. The handling of discipline varies greatly from instructor to instructor, but there are some tried theories and practices that are usable in most cases. See references listed.		

AGRICULTURAL

Module SHOP MANAGEMENT AND EQUIPMENT UTILIZATION 01.0305-01

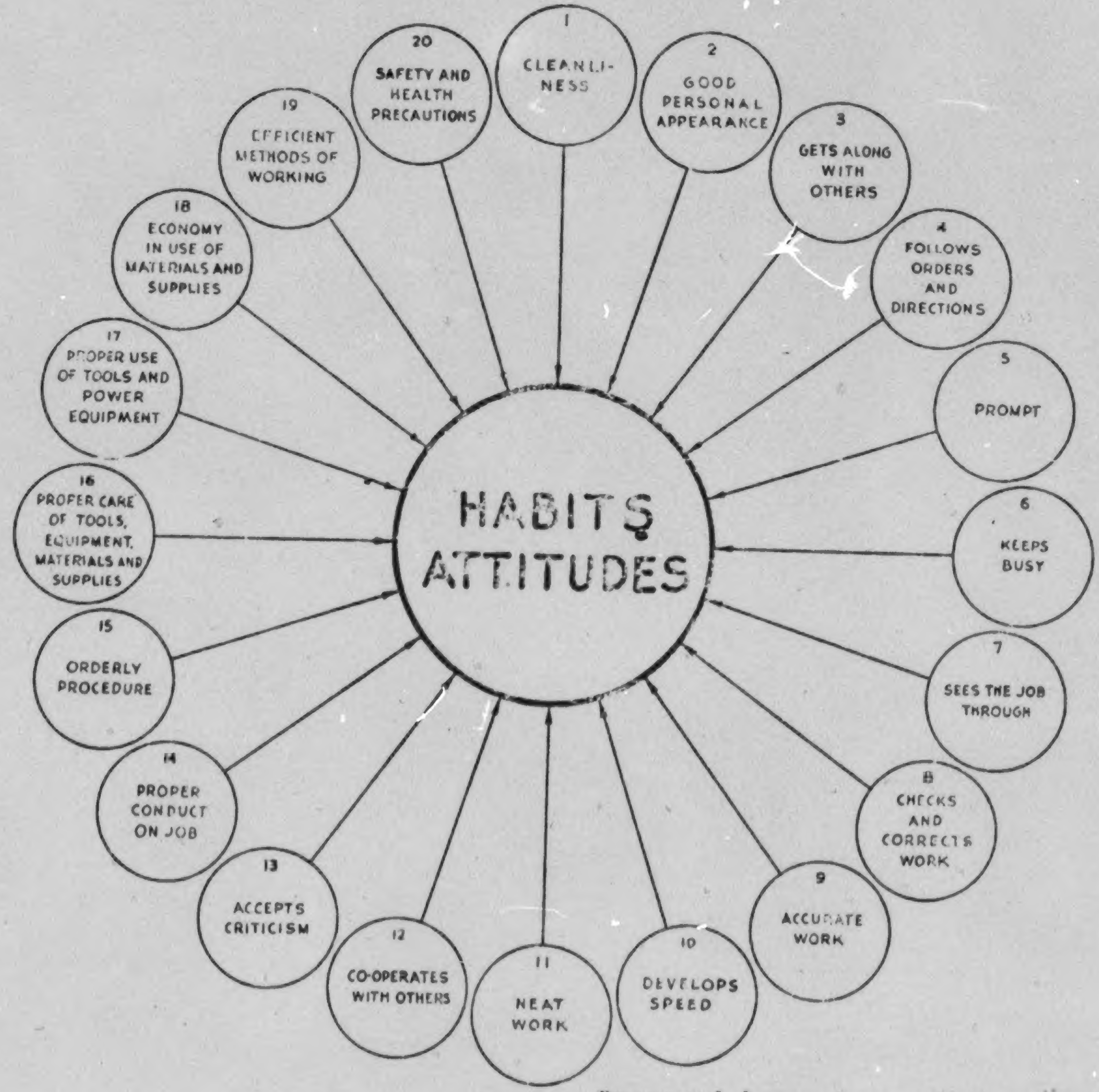
OBJECTIVES BY UNIT	CONTENT

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
F. A few basic regulations are necessary in any shop. First, there are the rules covering safety and orderly routines of shop management that need to be enforced. If they are described clearly to the group, and the need for them pointed out, they will usually be accepted without question, and observed reasonably well from the beginning.		

WORK HABITS AND ATTITUDES

TRADE SKILLS — TRADE KNOWLEDGE
AND
DESIRABLE WORK HABITS

WANTED BY ALL EMPLOYERS


HABITS
ATTITUDES
1 CLEANLINESS
2 GOOD PERSONAL APPEARANCE
3 GETS ALONG WITH OTHERS
4 FOLLOWS ORDERS AND DIRECTIONS
5 PROMPT
6 KEEPS BUSY
7 SEES THE JOB THROUGH
8 CHECKS AND CORRECTS WORK
9 ACCURATE WORK
10 DEVELOPS SPEED
11 NEAT WORK
12 CO-OPERATES WITH OTHERS
13 ACCEPTS CRITICISM
14 PROPER CONDUCT ON JOB
15 ORDERLY PROCEDURE
16 PROPER CARE OF TOOLS, EQUIPMENT, MATERIALS AND SUPPLIES
17 PROPER USE OF TOOLS AND POWER EQUIPMENT
18 ECONOMY IN USE OF MATERIALS AND SUPPLIES
19 EFFICIENT METHODS OF WORKING
20 SAFETY AND HEALTH PRECAUTIONS

Prepared by members of the staff
of Dunwoody Industrial Institute

SHOP PERSONNEL DUTIES

Shop Superintendent

Checks attendance, student work clothes, and assigns substitutes to duties not covered. He aids the Instructor in providing students with assistance, materials or special tools where necessary. He gives the signal and oversees the clean-up and reports to the instructor.

Assistant Superintendent

Assists the Superintendent where necessary and acts for him in his absence. His one responsibility during the afternoon session is attendance card pick-up.

Tool Foreman

Checks for and replaces tools to their proper location, inspects tool chests and/or cabinets for dirty or defective tools. Locates missing or new tools where they will be of more usefulness to entire group. Reports any broken, damaged, and lost tools to the instructor.

Tool Clerk

Assist the foreman by checking open tool panels and replacing all tools especially the small engine bench tools and also the welding bench tools.

Bench Foreman

Checks, clears and/or cleans all bench tops not taken care of by individual student worker. Replaces and organizes reference manuals on library shelves.

Maintenance Man

Performs minor repairs, parts or supply storage, also maintenance to shop equipment or vehicles as assigned by the instructor.

Welding Supervisor

Checks the welding area for needed clean-up and performs that necessary. Checks equipment for proper storage such as: machines in proper place, cables hung in orderly manner, hand and head shields stored on rack orderly, gloves also neat and orderly on rack, electrode supply stored orderly and containers opened as necessary.

Materials Supervisor

Checks stock of large materials for proper storage and orderliness such as: steel and pipe, lumber and new machinery brought in for assembly. Other supply items such as cleaning clothes, floor sweeping compounds, bolt stock, etc. must be cared for and inspected weekly.

SHOP PERSONNEL DUTIES CONT'D

Safety Man

Reports any unsafe conditions and unsafe acts to the instructor. He eliminates such hazards as slippery floors, clogged exit doorways, etc. which he recognizes as being trouble spots. He will routinely check fire extinguishers for proper pressure and place. Make certain all dirty oily clothes are in the safety cans, also that exhaust systems are operating.

Machine Foreman

Checks all major machines, brush clean of dust, dirt, etc. and/or wipes dry of water, oil or grease from items such as: bench grinders, drill press, portable welders, power hacksaw, valve grinder. brake lining machine, dynamometer, high pressure greaser and lube dispenser;also the steam cleaner and parts cleaner.

Jack Foreman

Locates and stores all portable hydraulic jacks, jack stands and/or blocking materials. Wipes clean of dirt, oil or grease;keeps all such items in an orderly safe location. Reports any damage or malfunction and missing items to the instructor.

Sweepers

Sweeps the complete open floor and aisle areas in that section of the shop so designated and disposes of accumulation in the proper receptacle. Picks up any item or materials that have been dropped and missing which are useable and/or belonging to some machine or equipment in the shop.

Substitute

Performs jobs of students who are absent as assigned by the Shop Superintendent or Instructor.

Period of Responsibility

SHOP DUTIES SCHEDULE

Time Periods →

NAMES														
	1	10	9	8	7	6	5							
	2	1	10	9	8	7	6							
	3	2	1	10	9	8	7							
	4	3	2	1	10	9	8							
	5	4	3	2	1	10	9							
	6	5	4	3	2	1	10							
	7	6	5	4	3	2	1							
	8	7	6	5	4	3	2							
	9	8	7	6	5	4	3							
	10	9	8	7	6	5	4							

1. Shop Supt.
2. Asst. Supt.
3. Tool Foreman
4. Bench Foreman
5. Maintenance Man
6. Substitute
7. Sweeper A
8. Sweeper B
9. Sweeper C
10. Sweeper D

MODULE OF INSTRUCTION

Title - SHOP MANAGEMENT AND EQUIPMENT UTILIZATION Code - 01.0305-01

RESOURCE MATERIALS

Books -

Teacher references:

1) Teaching Vocational Agriculture. Garris, McGraw Hill Book Co. New York, N.Y.

2) The Instructor and His Job. Rose. American Technical Society. Chicago, Ill.

3) School Shop Management. The State Education Department. Albany, N.Y.

4) Form Shop Skills. Sampson, Mowery, Kugles. American Technical Society. Chicago, Ill.

5) Shop Safety Education. The State Education Department. Albany, N. Y.

Student references:

1) Shopwork on the Farm. Jones. McGraw Hill Book Co.

2) Tool and Hardware Identification Manual. California State Polytechnic College.

3) FOS Manual - General. John Deere Company. Moline, Ill.

Audiovisuals -

Film: ABC's of Hand Tools. General Motors. Detroit, Mich.

Use and Care of Handtools. Purdue University. Lafayette, Ind.

MODULE OF INSTRUCTION

Title - BASIC AGRICULTURAL WELDING Code - 01.0305-02

RESOURCE MATERIALS

Bulletins -

#328 Selection of Welding Equipment. Fred G. Lechner. Cornell University.

#345 Selection of Filler Metals. Fred G. Lechner. Cornell University.

VAS-3004 Arc Welding. IMS University of Ill.

VAS-3001 Using the Oxy-Acetylene Flame. IMS University of Ill.

Periodicals -

Stabilizer. Lincoln Electric Company. Cleveland, Ohio.

Distributor Progress. Linde, Union Carbide Company. New York, N.Y.

Welding in Your Enterprise. Eutectic Corporation. Flushing, N.Y.

Audiovisuals - Filmstrips

Learning Arc Welding Skills, #1, #2, #3. James F. Lincoln Welding Foundation. Cleveland, Ohio.

Arc Welding Series 123000. McGraw Hill Book Company. New York, N.Y.

Oxy-Acetylene Equipment - Setting up the Equipment and Lighting the Torch. California State Polytechnic College. San Luis Obsipo, Calif.

Movies

Arc Welding Electrode Selection. 24 min. color. Hobart Bros.. Troy, Ohio.

Welding Corners to the Farm. 24 min. B&W. Farm Film Foundation. Washington, D.C.

Foundamentals of Manual Shielded Arc Welding. 40 min. color. Purdue University. Lafayette, Ind.

The Oxy-Acetylene Flame — Master of Metals. 19 min. color. U.S. Bureau of Mines. Pittsburg, Penn.

MODULE OF INSTRUCTION

Title - BASIC AGRICULTURAL WELDING Code - 01.0305-02

DESCRIPTION:

Skills will be developed for the simple welding needed on the farm or in the equipment dealership, around a nursery, in greenhouse operation, or in connection with many conservation activities. The student will set up and operate both arc and gas welders and will gain basic proficiency in making welds in the flat and horizontal positions. He will learn and use safe procedures and precautions in all activities. This module will provide the foundation for further instruction in welding or for individual development for those who need greater proficiency.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Arc welding, safety, equipment and supplies	3	2
2. Basic procedures and patterns	2	4
3. Oxy-acetylene equipment	1	5
4. Flat position welding	1	12
	7	23

Revised June, 1974

MODULE OF INSTRUCTION

Title - BASIC AGRICULTURAL WELDING

Code - 01.0305-02

OBJECTIVES to be obtained:

The student will be able to:

1. Define, verbally or in written form, arc welding to the satisfaction of the instructor.
2. List 5 hazards common to arc welding.
3. List 2 safety procedures to use in correcting each of the 5 hazards associated with arc welding.
4. Identify 3 welders used in the shop by size, type and electrical output.
5. Demonstrate the proper setup of welder and adjustment of amperage for a given electrode situation.
6. Select the proper size of electrode to be used for welding various thickness of metal up to one-half inch.
7. Identify electrodes by AWS classification number and NEMA color code for welding mild steel using a wire gauge and wall charts containing AWS and NEMA information.
8. Demonstrate proper handling and storage of welding electrodes.
9. Strike an arc and maintain to the satisfaction of the instructor.
10. Lay a high quality bead which would indicate correct penetration and minimum amounts of undercutting or overlapping.
11. Develop skill in laying high quality beads of extra width by using an oscillating motion.
12. Develop skill in laying beads in smooth, even layers using it to build up worn parts.
13. Demonstrate the safe handling of oxy-acetylene and equipment.
14. Adjust the regulators, torch and flame properly for use in cutting metal.
15. Answer questions concerning the oxy-acetylene process particularly as it relates to basic characteristics.
16. Cut mild steel using hand-cutting torch with the correct speed of travel, tip size and amount of gas pressure.

MODULE OF INSTRUCTION

Title - BASIC AGRICULTURAL WELDING Code - 01.0305-02

OBJECTIVES to be obtained:

The student will be able to:

17. Answer questions about cutting different metals posed in the class.

18. Develop skill in manipulating the electrode for making a strong, sound fillet weld.

19. Demonstrate skill in welding the multiple pass in proper sequence with required strength.

20. Successfully join two pieces of metal together in a butt joint by welding.

Module BASIC AGRICULTURAL WELDING 01.0305-02

OBJECTIVES BY UNIT	CONTENT
Unit 1 Arc welding, safety, equipment and supplies. Objective #1 The student will verbally, or in written form, define arc welding to the satisfaction of the instructor.	A. What is arc welding? . Joining of two pieces of metal . The electric arc B. Action of the arc. C. Arc welding circuit. . Control . High amperage - low voltage D. Welder's job. . Select size and type of rod . Adjust machine . Joint preparation
Objective #2 The student will list 5 hazards common to arc welding after an orientation session and visual examination of shop and welding area.	A. Hazards most common to welding. . Electric shock . proper electrical connections . inspect cables and connectors for defects and repair or replace . wear good gloves . avoid wet floors or ground . Burns . protect face and eyes . wear proper clothing, etc. . wear good gloves . twist stuck electrode free before removing shield and use pliers to hold hot electrode

Module BASIC AGRICULTURAL WELDING 01.0305-02

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Explain and demonstrate just with ice cubes - melting and then the freezing which joins the two pieces into one. B. Use two pieces of parafin and heat with the flame from a candle or torch, press together and allow to cool which forms the two into one solid piece C. Using the arc welder and an electrode, adjust machine amperage and demonstrate the arc gap just very close and then long.	Observe demonstration and try out the procedures shown by the instructor.	Write the definition of the arc welding process and how to use it in the repair or maintenance of equipment.
A. Discuss methods of care and inspection of electrical connections of welding machine in shop. B. Demonstrate the proper inspection of head and/or face shields, also the replacement of lens. C. Use arc welder and electrode to cut galvanized metal showing how fumes are given off.	A. Inspect machines and other equipment for possible hazards. B. Make a list of possible unsafe procedures and check fellow students understanding. C. Advise instructor of any hazards and/or defective equipment. D. Check first aid cabinet and location for supplies. E. Make note of location of fire protection equipment.	Check the list against the master.

OBJECTIVES BY UNIT	CONTENT
Objective #3 The student will list 2 safety procedures to use in correcting each of the 5 hazards associated with arc welding.	A. Radiant energy . Protect eyes before striking arc on metal . Check head and face shields for cracked or broken lens . In case of direct flash, treat eyes with butyne preparation B. Gases and fumes . Ventilate shop properly when welding . Special precautions when welding metals containing zinc . Forced ventilation when welding in confined areas . Drink sweet milk to overcome nausea resulting from welding where zinc oxide fumes are present C. Combustible materials . Clean shop welding area frequently . Never weld around uncovered containers of flammable materials . Safe guard containers to be welded that have contained combustible materials by steam, carbon monoxide, or other protective methods

Module BASIC AGRICULTURAL WELDING 01.0305-02

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
D. Inspect shop arc and point out possible places where fire protection measures can be improved. E. Demonstrate the use of the exhaust from a gasoline engine for safeguarding a container before welding. F. Demonstrate and discuss first aid procedures. Show where the supplies for first aid treatment are located. G. Warn them to never rub their eyes if they get foreign particles in them. H. Remind the students that if they are careful they will not need first aid.	Working in small groups - put on demonstration of a safe practice to follow.	Check each students list and/or oral presentation of the safety procedures to use.

OBJECTIVES BY UNIT

Objective #4

The student will identify 3 welders used in the shop by type, size and electrical output.

Objective #5

The student will demonstrate the proper setup of welder and adjustment of amperage for a given electrode situation.

Objective #6

The student will select the proper size of electrode to be used for welding various thickness of metal up to one-half inch.

Objective #7

The student will identify electrodes by AWS classification number and NFMA color code for welding mild steel using a wire gauge and wall chart containing AWS and NFMA information.

Objective #8

The student will demonstrate proper handling and storage of welding electrodes.

CONTENT

A. Welding machines.
  . Types
    . AC 230 volt
    . DC generator or rectifier
    . AC-DC combination
  . Size
    . limited input - 180-225 AMP
      37 1/2 AMP, draw
    . industrial - 230-600 AMP
      42 AMP & UP, draw
  . Estimating cost of operation
B. Accessories.
  . Current carrying cables
  . Electrode holder
  . Ground clamp
  . Chipping hammer and brush
  . Shield for face and eyes
  . Gloves and apron
  . Safety glasses or goggles
  . Carbon arc torch

C. Electrodes
  . Sizes
      3/32
      1/8
      5/32
  . Amperage setting
    . quality of weld
    . penetration
    . welding speed
  . AWS classification
    . letter E
    . first two digits - tensile strength
    . third digit - position
    . fourth digit - subgrade, etc.
  . NEMA color codes
    . standardized markings
  . Electrode storage

EDUCATION

Module BASIC AGRICULTURAL WELDING 01.0305-02

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Show and discuss the various welders in the shop that students will have a chance to use.	A. Observe instructors demonstrations and explanations of the various machines.	A. Use a check sheet and identify various welding machines and accessories.
B. Explain the meaning of the limited-input type transformer arc welder.	B. Set up the welding equipment for practice welding and check for proper functioning.	B. Proper connection of a welder to its power source and adjustment of the amperage for a specific electrode.
C. Demonstrate the necessary service to the various arc welders in the shop.	C. Adjust the amperage control for the various size electrodes to be used in welding.	C. Select a group of electrodes to be sorted and identified by sizes.
D. Show how the amperage is adjusted and proper method using or connecting the various accessories.	D. Select one machine and determine the cost of electricity it will use during an hour of use.	D. Select from the same group of electrodes the rod to be used for a given job assigned by the instructor and check students' identification for accuracy.
E. Give a simple demonstration of the computations for determining the operational cost of welding.	E. Replace a defective color lens in the head or face shield being used to weld in the shop.	E. Check each students' handling and storage by observing and recording actions at the cleanup time where the student is welding.
F. Demonstrate the proper method of chipping and cleaning the finished weld.	F. Use the metal gauge and check sizes of various electrodes.	
G. Use a metal gauge for comparing electrode sizes.	G. Check a group of electrodes provided by instructor with a manufacturer wall chart.	
H. Demonstrate the use of manufacturer wall charts for selecting rod and amperage.	H. Select electrodes from a box by the AWS classification and NFMA color code.	
	I. Put shipment of electrodes away in the shop storage facility.	

AGRICULTURAL

Module BASIC AGRICULTURAL WELDING

01.0305-02

OBJECTIVES BY UNIT	**CONTENT**
Unit 2 Basic procedures and patterns Objective #9 The student will strike an arc and maintain to the satisfaction of the instructor.	A. Preparing to weld. . Check area for all necessary materials and equipment . Adjust machine amperage B. Striking the arc. . Methods . scratching . tapping . Correct arc length . long arc to pre-heat metal . short arc - approximate diameter of electrode
Objective #10 The student will lay a high quality bead which would indicate correct penetration and minimum amounts of undercutting or overlapping.	C. Running a bead. . Using correct amperage . Maintaining proper electrode angle . 15° to 25° in direction of travel . perpendicular to metal . Follow straight line made by snapstone or chalk . Form bead according to standards . 1 1/2 times width of diameter of electrode D. Restarting an interrupted bead. . Strike arc ahead of crater . Return to crown and start bead E. Recognize a good bead. . Compare with . pictures . actual specimens

EDUCATION

Module BASIC AGRICULTURAL WELDING 01.0305-02

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
I. Identify the various AWS numbers and NEMA color marking on the electrodes to be used. J. Show the students storage facility used for shop electrodes and explain the reasons for this method of storage.		
A. Demonstrate the importance of having all materials and equipment accessories at hand when starting to weld. B. Explain and demonstrate the methods of striking the arc with correct amperage and arc length. C. Review by discussion - . Amperage setting or adjustment . Welder's stance and comfort . Electrode angle and correct arc length . Balance between travel rate and amperage . Penetration . Bead buildup and conformation D. Demonstration . Effects of amperage variation . Effects of electrode angle	A. Check the area in which he is to be welding in prior to starting the welder for necessary items. B. Practice striking the arc and adjust to proper amperage and arc length. C. Practice running beads on scrap metal until a satisfactory bead is made for evaluation. D. Continue practice by ending a bead and then restarting the arc making a smooth continuous bead. E. Compare welded beads with a specimen provided by the instructor which has been prepared by a certified welder.	A. Check each students' procedure and have students demonstrate proper procedure. B. Student submit a specimen weld for evaluation that shows his ability to make a good weld bead. C. Students select specimens of good welded beads.

OBJECTIVES BY UNIT	**CONTENT**

Objective #11
The student will develop skill in laying a high quality bead of extra width by using an oscillating motion.
	A. Weaving.
	. Purpose
	  . covering wide area
	  . keeping molten puddle larger
	. Motions or designs
	  . vee-type
	  . crescent type
	  . circular
	  . figure 8

Objective #12
The student will develop skill in laying beads in smooth even layers and using it to build up worn parts.
	B. Padding.
	. Purpose
	  . building up worn areas
	. Select proper electrode
	  . mild steel for steel port
	  . use 1/8 or 5/32 size
	. Procedure
	  . alternative layer of stringer beads
	  . Weave beads

Unit 3 -
Oxy-acetylene equipment
Objective #13
The student will demonstrate the safe handling of oxy-acetylene and equipment.
	A. Safety.
	. Nature of the gases
	  . characteristics of acetylene (Hydrocarbon O_2H_2)
	  . oxygen
	B. Handling of oxygen and acetylene.
	. Oxygen
	  . three sizes of containers (244 cu.ft., 122 cu.ft., 80 cu.ft.)
	  . effects of temperature
	  . protection cap over valve
	. Acetylene
	  . formed by mixture of calcium carbide and water
	  . colorless gas
	  . nauseating odor
	  . stable under low pressure (15 psi)
	C. Equipment setup procedure.
	. Fasten cylinders in vertical position
	. Remove caps from cylinders
	. Crack valves of each cylinder then close valves

Module BASIC AGRICULTURAL WELDING 01.0305-02

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Discuss the use of wide stringer beads, the patterns for weaving, and amperage setting for this type of welding.	A. Observe the instructors demonstration and then practice the various weave patterns on scrap metal.	A. Prepare a specimen of three different patterns of weave and submit for instructors evaluation.
B. Demonstrate the weave bead by laying down two stringer beads and then use the various patterns discussed to fill in-between.	B. Practice the padding techniques on scrap until it is very similar to the instructors specimen.	B. Submit a part from a piece of machinery that has been repaired by the padding technique.
C. Explain factor of controlling the buildup of heat and the problem of slag entrapment in building a pad.	C. Obtain a worn part from a piece of machinery and use the two skills developed to repair the part for continued use.	
A. Define and explain the nature of the gases using references listed at the end of this module.	A. List the information given by the instructor on the nature and characteristics of the gases.	A. Check each students' ability to demonstrate the proper method safe handling of equipment.
B. Discuss the characteristics and the proper handling of these gases in the various containers available.	B. Observe the demonstration of the proper handling of gases in their containers and be ready to show how it is done.	
C. Discuss the following factors with students: • Oxygen and acetylene connections are not interchangeable • The two ways that oxygen hoses can be distinguished from acetylene hoses	C. Work in small groups to practice proper methods of handling.	
	D. Participate in discussion and observe demonstration, obtain the answers to the following questions: • Why must the acetylene cylinder be kept in the vertical position?	

OBJECTIVES BY UNIT	CONTENT
	. Connect oxygen regulator to oxygen cylinder . turn adjusting screw on regulator until . tension on spring is released . slowly turn oxygen cylinder valve wide open . Connect acetylene regulator to acetylene cylinder . turn adjusting screw on regulator until tension on spring is released . open cylinder valve 1/4 to 1/2 of a turn . Connect hoses to regulators . purge hoses . Connect torch body to hoses . purge torch assembly . Test for leaks with soap suds and water . use Ivory soap for making suds
Objective #14 The student will adjust the regulators, torch and flame properly for use in cutting metal. Objective #15 The student will answer questions concerning the oxy-acetylene process particularly as it relates to basic characteristics.	D. Regulators, torch and flame adjustment. . Open acetylene valve on torch - 1 turn . turn adjusting screw on acetylene regulator until desire pressure is reached . close acetylene valve on torch . Repeat steps 1, 1-a and 1-b with oxygen . Hold torch in right hand, if right handed, left hand, if left handed. . Open acetylene torch valve 1/4 turn . Light torch and adjust till smoke on flame clears . Open oxygen valve slowly . Adjust to carburizing flame . feather on inner cone is 1 to 3 times longer than inner cone . Adjust to neutral flame . leave traces of feather on inner cone . Adjust to oxidizing flame . no feather and flame will be blue to ice blue in color . Close both torch valves . Close both cylinder valves . Open both torch valves and release pressure . After regulator gauge needles return to 0 release adjusting screws . Place torch and hose on hangers or brackets provided.

EDUCATION

Module BASIC AGRICULTURAL WELDING 01.0305-02

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
D. . The kind of soap to be used for suds in testing for leaks . The various precautions to be taken with equipment. E. Advise students of the following precautions: . Never use oil on any welding equipment . Keep cylinders in vertical position . Tighten connections tightly but do not force, in event of leak.	D. . What is the purpose of the caps on the tanks during transportation? . What is the maximum safe operating pressure for acetylene and why? . What does the effect of temperature have on the pressure in a cylinder? . Why should cylinder valves be shut off when we are through using equipment for any length of time?	
A. Outline and discuss the steps in adjusting the flame. B. Explain the reason for the following: . Why we do not use more than 15 psi pressure on an acetylene line . Using pressures recommended by the equipment manufacture. . What will result if excessive acetylene escapes into the air. C. Demonstrate the torch adjustments for: . Carburizing flame . Neutral flame . Oxidizing flame	A. Participate in discussion and observe demonstration, obtain the answers to the following questions: . How can we tell when we have a neutral flame? . How much oxygen (parts) does it take to burn one part of acetylene in the neutral flame? . Why is the acetylene gas turned off first? . What effect does oxidizing flame have on the molten metal? . How many parts of oxygen are supplied from the tank for a neutral flame? . What is acetylene gas made from? . What other gases can be used for cutting metal?	A. Check each students' ability to adjust torch and regulators for cutting. B. Grade quiz.

OBJECTIVES BY UNIT	**CONTENT**
Objective #16 The student will cut mild steel using handcutting torch with the correct speed of travel, tip size and amount of gas pressure. Objective #17 The student will answer questions about cutting different metals.	E. Oxy-acetylene flame cutting. . Use manufacturer's charts for correct tip size, oxygen and acetylene pressures for thickness of of metal to be cut. . Select tip and adjust pressures . Adjust to a neutral flame with cutting jet open . Cut . hold tip at right angle to work and inner cone about 1/8" above work . heat starting point to bright red, press cutting level on assembly and move slowly enough in direction of travel to maintain cut . If cutting action stops, release cutting lever and preheat edge where cutting action stopped

EDUCATION

Module BASIC AGRICULTURAL WELDING 01.0305-02

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Demonstrate the procedure to the class for making a good cut in 1/4" steel.	A. Observe demonstration and list the steps in the procedure for flame cutting.	A. Check specimen cut made against a professional cut piece and evaluate on the basis of smoothness of kerf distinctness.
B. Provide material for students to make practice cuts to be able to develop ability.	B. Check the charts and select a tip for cutting the piece of metal provided by the instructor for practice.	B. Answer quiz questions prepared from the factors discussed and demonstration given.
C. Discuss the following: • The chemical action that takes place in oxy-acetylene cutting • The purpose of the preheat flames • The kerf in oxy-acetylene cutting • The metals that can be cut with oxy-acetylene • The number of preheat holes in the average cutting tip. • The reason that the preheat flames should not touch the metal • The reason for using only the amount of oxygen recommended by the tip manufacturer • How you check speed of travel	C. Write out the answers to the following questions: • Why does cutting cast iron differ from cutting steel? • Name the different orifices in the flame end of a cutting tip. • What causes the excess of slag at the bottom of a cut? • How would you cut two or more thicknesses of metal? • What happens if the torch is moved too fast? • How do you determine the oxygen pressure to use?	

Title - BASIC AGRICULTURAL WELDING

OBJECTIVES BY UNIT	CONTENT
Unit 4 - Flat position welding Objective #18 The student will develop skill in manipulating the electrode for making a strong, sound fillet weld.	A. Fillet welds - single pass. . Set amperage for electrode and metal thickness . Tack weld two pieces together . 1/4 to 3/8 inch long at each end . clean and remove slag . Electrode angle . 45 degrees to plates . 15 to 25 degrees in direction of travel . Run beads . hold arc gap 1/16 to 1/8 inch from metal . arc slow, steady movement of electrode; observe action within the arc at all times . Chip and inspect weld . determine if ripples are even . check for penetration into the throat of the weld and if legs of the weld are equal in length
Objective #19 The student will demonstrate skill in welding the multiple pass in proper sequence with required strength.	B. Fillet weld - multiple pass. . More strength can be secured . Proper sequence . first pass laid in the corner with higher amperage than normal . succeeding passes are laid in the grooves working from bottom to top

01.0305-02 - Code

BASIC AGRICULTURAL WELDING - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Discuss: . Positioning and tacking the tee joint . Fillet beads - concave versus convex. . Effect of: amperage, electrode angle, and travel speed . Penetration . Undercutting . Arc length control . Weaving final pass B. Demonstrate all of the above with a variation to show results of correct and incorrect method.	A. Observe demonstration and ask questions during discussion of the factors shown. B. Obtain pieces of metal for practice and set up, tack in position and weld until one will compare satisfactory with instructors specimen.	Provide a specimen weld for comparison and evaluation to meet instructors satisfaction.
A. Illustrate on the chalk board or with handout sheets the proper sequence of the weld passes. B. Demonstrate this technique, emphasize the steady regular forward motion to make the weld smooth. C. Show how the whip can again be used as an alternate technique. Compare the case of making the weld with the steady movement as compared to the whip.	A. Observe procedure demonstrated by the instructor. B. Obtain practice pieces and concentrate on penetration and evenness and smoothness of bead.	Submit specimen for instructors evaluation.

OBJECTIVES BY UNIT	CONTENT

Objective #20
The student will sucessfully join two pieces of metal together in a butt joint by welding.
	C. Butt welds.
	. Adjust amperage for electrode and metal thickness
	. Type of joints
	  . closed square butt
	  . open square butt
	  . vee butt
	. Position of electrode maintained at perpendicular, 15 to 25 degrees in direction of travel.
	. Multiple pass sequence is similar to that used in fillet welds.
	. Tack joints to prevent distortion
	. Clean and inspect finished weld for degree of penetration, fusion or slag inclusions

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Discuss: . Distortion during butt welding due to; heat and expansion . Tacking and joint strength . Amperage and penetration . Uniform penetration and bead strength . Bead appearance versus bead quality . Bead testing of butt welds B. Demonstrate: . Joint fitting . Joint spacing . Joint tacking . Amperage variation effects . Welding on one side of a butt weld joint on 1/8 inch metal with E6013 electrode . Multiple-pass beads with E6013 electrodes on one side of a butt weld joint of 3/16 inch metal.	A. Participate in discussion asking questions about those variables that are not understood. B. Observe demonstration and obtain pieces for practice.	Submit specimen weld of each of the three types of butt welds for the instructors evaluation.

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Title - BASIC AGRICULTURAL WELDING   Code - 01.0305-02

RESOURCE MATERIALS

Books -

Teacher references:

1) New Lessons in Arc Welding. Lincoln Electric Company.
2) Arc Welding Lessons for School and Farm Shop. H. L. Kugler. James F. Lincoln Foundation.
3) Metals and How to Weld Them. T. B. Jefferson and Gorham Woods. James F. Lincoln Foundation.
4) Farm Welding — Arc and Oxy-acetylene. Marion M. Parker. McGraw-Hill Book Company.
5) Welding Skills and Practices. Giachino, Weeks, Brune. American Technical Society.
6) Oxy-Acetylene Handbook. Linde Union Carbide Corporation.

Student references:

1) Arc Welding Instructions for the Beginner. H. A. Sosin. James F. Lincoln Foundation.
2) Arc and Tig Welding Basic Manual. Sellon and Matthews. James F. Lincoln Foundation.
3) Shopwork on the Farm. Jones. McGraw-Hill Book Company.
4) Farm Shop Skills. Sampson, Mowery, Kugler. American Technical Society.

MODULE OF INSTRUCTION

Title - ADVANCED AGRICULTURAL WELDING

Code - 01.0305-03

DESCRIPTION:

Building upon basic skills previously acquired, this module emphasizes further development of skills in welding and their practical application to agricultural equipment. Included will be vertical and overhead arc welds as well as heating, bending, brazing, hardsurfacing, and soldering. Safety for the operator and others will be stressed.

DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Selection of Electrodes	½	1
2. Evaluating Welds	½	2
3. Overhead and Vertical Welding	1	9
4. Welding Cast Iron	1	3
5. Hardsurfacing and Padding metal	1	4
6. Heating and bending metal	1	2
7. Soldering and brazing metal	1	3
	6	24

Revised June, 1974

MODULE OF INSTRUCTION

Title - ADVANCED AGRICULTURAL WELDING   Code - 01.0305-03

Objectives to be obtained:

The Student will develop and demonstrate the effective ability to:

1. Perform Vertical up and Vertical down welds, using recommended electrodes, to exceed minimum standards set by the instructor.
2. Perform overhead welds, using recommended electrodes, to exceed minimum standards set by the instructor.
3. Weld cast iron, to exceed minimum standards set by the instructor, using the arc welder and the oxyacetylene welder.
4. Hardsurface metal, to exceed minimum standards set by the instructor, using the arc welder, carbon arc torch and the oxyacetylene outfit.
5. Bend and shape metal to given specifications using the carbon arc torch and oxyacetylene outfit as sources of heat.
6. Solder and braze metal to given specifications using materials and various sources of heat as directed by the instructor.

AGRICULTURAL

Module ADVANCED AGRICULTURAL WELDING 01.0305-03

OBJECTIVES BY UNIT	CONTENT
Unit 1. Selection of Electrodes	A . Identifying Electrodes . American Welding Society (AWS) classification . Color coding system . Electrode sizes B . Selecting electrodes . Identifying metal to be used on . spark test . color . Using selection guides . wall charts . handbooks
Unit 2. Evaluating Welds	A . Methods of evaluating welds, . External Visual inspection . Break tests (strength of weld) . Inspection of penetration B . Determining causes for faulty welds, . Incorrect heat . Incorrect electrode or rod . Poor motion . Wrong speed . Inadequate metal preparation . Other

EDUCATION

Module ADVANCED AGRICULTURAL WELDING 01.0305-03

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture - discussion Review selection of electrodes. B. Student practice	A. Update notes from previous module or take note of new information. B. Students practice identifying metal to be welded, and selecting the appropriate rod or electrode to be used.	A. Written test B. Evaluate students ability to select appropriate electrode for a given problem. C. Observe students ability to select correct electrodes throughout module.
A. Lecture - discussion of evaluation methods. B. Demonstration of evaluation procedures. C. Student practice.	A. Take note of new information. B. Evaluate welds made during the module for the instructor.	A. Evaluate students ability to evaluate his welds and determine causes for problems. (Students should evaluate their welds with the instructor throughout the module, a weld evaluation form may be useful to be filled in by the student and checked by the instructor.

Module ADVANCED AGRICULTURAL WELDING

OBJECTIVES BY UNIT	CONTENT
Unit 3. Overhead and Vertical Welding Objective #1 Perform Vertical up and Vertical down welds, using recommended electrodes, to exceed minimum standards set by the instructor.	A. Vertical Welds . Vertical down welds. . proper electrode . position . length of arc . motion . Vertical Up Welds . proper electrode . position . length of arc . motion . recommended amperage
Objective #2 Perform overhead welds, using recommended electrodes, to exceed minimum standards set by the instructor.	A. Overhead Welds . Proper electrode . suitability . size . Length of arc . Travel time . Recommended amperage . Protective Clothing needed

EDUCATION

odule ADVANCED AGRICULTURAL WELDING 01.0305-03

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A . Lecture - discussion B . Demonstration C . Student practice	A . Take note of new information B . Observe demonstrations C . Practice Vertical up and Vertical down welding. D . Study references E . Evaluate welds with instructor.	A . Evaluate students progress during practice sessions. B . Evaluate welds done on assigned test blocks.
A . Lecture discussion B . Demonstration C . Student Practice	A. Take note of new information B. Observe demonstrations. C. Practice overhead welding. D. Study references. E. Evaluate welds with instructor.	A. Evaluate students progress during practice sessions. B. Evaluate welds done on assigned test blocks.

AGRICULTURAL

Module ADVANCED AGRICULTURAL WELDING 01.0305-03

OBJECTIVES BY UNIT	**CONTENT**
Unit 4. - Welding Cast Iron Objective 3. Weld cast iron, to exceed minimum standards set by the instructor using the arc welder and oxyacetylene outfit.	A . Cast Iron . Properties of cast iron . over 1.72 carbon . brittle . Types of cast iron . white . gray . malleable . Identifying type of cast iron - spark test and color B . Welding Cast Iron . Arc . preheating . amperage . motion 1. backstep 2. partial welding . penetration needed . cooling methods . electrode selection . Oxyacetylene . preheating . tip size . motion . penetration . use of flux . cooling methods . rod selection
Unit 5. - Hardsurfacing and Padding metal. Objective 4. Hardsurface metal, to exceed minimum standards set by the instructor, using the arc welder and the oxyacetylene welder.	A. Benefits of Hardsurfacing B. Selecting hardsurfacing electrodes . Metal to ground wear . Metal to metal wear . Impact wear C. Techniques of hardsurfacing . Figure eight . Crescent . Wash pass

Module ADVANCED AGRICULTURAL WELDING 01.0305-03

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture - Discussion B. Demonstration 1. Types of cast iron 2. Welding cast iron C. Student practice	A. Take note of new material B. Practice welding cast iron using arc welders and the oxyacetylene outfit. C. Evaluate welds.	A. Observe students progress during practice sessions. B. Evaluate welds done on given test blocks.
A. Lecture - discussion B. Demonstration C. Student practice	A. Take note of new material B. Practice padding C. Study reference material D. Evaluate welds	A. Evaluate test blocks completed by students.

AGRICULTURAL

Module ADVANCED AGRICULTURAL WELDING 01.0305-03

OBJECTIVES BY UNIT	CONTENT
Unit 6. Heating and bending metal. Objective # 5. Bend and shape metal to given specifications using the carbon arc torch and oxyacetylene outfit as source of heat.	A . Methods and procedures for heating metal . Arc Welder . carbon arc torch . Oxyacetylene unit. B . Procedure for shaping metal . Measuring and marking . Heating . Shaping . Cooling
Unit 7. Soldering and brazing metal Objective #6 Solder and braze metal to given specifications using materials and various sources of heat as directed by the instructor.	A . Differences among soldering, brazing, and welding . Strength . Heat required . Materials needed . Adherence vs. fusion . Procedures followed B . Brazing . Materials needed . Procedure to follow . When to use brazing C . Soldering . Materials needed . Procedure to follow . When to use soldering

Module ADVANCED AGRICULTURAL WELDING 01.0305-03

TEACHING METHOD	STUDENT APPLICATION ACTIVITY	EVALUATION PROCEDURES
A. Lecture - discussion B. Demonstration C. Student practice	A. Take note of new material B. Practice bending metal C. Study references	A. Evaluate assigned bending Project.
A. Lecture - discussion B. Demonstrations C. Student practice	A. Take note of new material. B. Practice soldering and brazing.	A . Evaluate assigned brazing and soldering project. . Safety . Procedure . Results

Student Evaluation Sheet for Advanced Agricultural Welding Module

Agriculture Welding Advanced

Each student will develop and demonstrate the effective ability to do the following:

1. Perform a vertical down weld using a blue dot electrode.
2. Perform a vertical up weld using a blue dot electrode.
3. Perform an overhead weld using a blue dot electrode.
4. Use the carbon arc torch and oxyacetylene unit as a source of heat to bend a test plate according to the instructors specifications.
5. Use the carbon arc torch and oxyacetylene unit to braze a test plate according to the instructors specifications.
6. Demonstrate hardsurfacing using the carbon arc torch as a source of heat, as specified by the instructor.
7. Demonstrate soldering using the following sources of heat as specified by the instructor:

   ______carbon arc

   ______oxyacetylene

   ______soldering iron

8. Weld cast iron according to the instructors specification.
9. Cut cast iron using the arc welder.

Instructor's Evaluation

NAME______________________

Date completed______________________

Evaluated By______________________

MODULE OF INSTRUCTION

Title - ADVANCED AGRICULTURAL WELDING　　Code - 01.0305-03

RESOURCE MATERIALS

BOOKS -

Metal Fusion and Fabrication Welding. Ohio State University.
Forney Arc Welding Manual. Forney Industries Inc.
Arc Welding lessons. Jones F. Lincoln Arc Welding Foundation.
The Oxyacetylene Handbook - Linde air products.

BULLETINS -

1. Students Guide for the Lincoln Short Course in Arc Welding (15¢) - Lincoln Electric Company.
2. Materials and Procedures for Soldering (E850) - Cornell Extension (10¢)
3. Using the Electric Arc Welder (S46) - Cornell Extension (50¢)
4. Using Oxyacetylene Welding Equipment on the farm - Cornell Extension (40¢)
5. Selection of Filler Metals for Farm Welding - Dept. of Agricultural Engineering - Cornell.

PERIODICALS - The Lincoln Stabilizer - Lincoln Electric Company.

AUDIOVISUALS - Excellent Transparencies, filmstrips and movies are available from sources such as I.M.S., California Polytech, NASCO, Lincoln Electric, Forney, and Westinghouse. Due to limited time they should be used only when the arc definitely is superior to a demonstration.

MODULE OF INSTRUCTION

Title - AGRICULTURAL MACHINERY PAINTING Code - 01.0305-04

DESCRIPTION:

This module is designed to expose the student to the various types of painting equipment required to properly apply paint to machinery. The student will prepare a machine for painting. He will select the proper paint, primer and thinner that are compatible. The procedures followed will illustrate to the student safe procedures required when painting. In addition to actual painting, he will maintain the equipment to insure long life of the equipment plus being in application condition the next time the equipment is to be used.

DIVISIONS OR UNITS OF CONTENT	Time Allocation	
	Class	Other
1. Introduction to Painting Equipment	3	6
2. Servicing Equipment	1	2
3. Preparation of Machine to be painted		8
4. Selecting proper paint and preparing for application	1	2
5. Applying paint, trim and decals	1	6
	6	24

Revised June, 1974

MODULE OF INSTRUCTION

Title - AGRICULTURAL MACHINERY PAINTING Code - 01.0305-04

OBJECTIVES to be obtained:

The student will be able to:

1. Identify the proper painting equipment necessary to perform a first class paint job in a safe manner.
2. Identify operational malfunctions and perform required maintenance to the equipment.
3. Prepare and adjust the equipment to properly operate painting equipment to obtain satisfactory results.
4. Make a proper paint and thinner selection and prepare it for application.
5. Properly prepare the machinery for applying primer and paint.
6. Apply trim and decals at the proper time for maximum adherence.

01.0305-04

Title - AGRICULTURAL MACHINERY PAINTING

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Introduction to Painting Equipment Objective 1 - Identify the proper painting equipment necessary to perform a first class paint job in a safe manner.	A. Spray Guns . Types . separate container -- attached container . bleeder -- non bleeder . external -- internal mix . pressure -- gravity -- suction feed . automatic -- extension . Components of Spray Gun . air cap . fluid tip . fluid needle . trigger . fluid adjusting screw . air valve . spreader adjusting valve . gun body
Unit 2 - Servicing Equipment Objective 2 Identify operational malfunctions and perform required maintenance to the equipment	. Types of Air Caps . external mix . internal mix . multi jet cap . advantages . selection procedure of air caps . selection procedure of fluid tip . Removal, cleaning and lubricating spray head . removal procedure . head cleaning procedure . immersing . air with solvent . problems of operation . air leakage . fluid leakage . jerky - fluttery spray . defective spray pattern . Hoses and connectors . type hose . size of hose . connector types . threaded . quick deback . Regulator -- Transformer . purpose of . components of . operation principles . Air compressor . type - . piston . diaphragm . single stage . two stage . portable or stationary

EDUCATION

01.0305-04 - Code

AGRICULTURAL MACHINERY PAINTING - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Slides - Overhead transparencies B. Lecture on - . Types of guns . Components of typical gun . Cleaning spray head . Regulators types . components of . Air compressor types . components of . Respirators . Spray booths C. Demonstrate . Cleaning spray head . Maintenance of regulator . Maintenance of compressor . Adjust pressure regulator . Dismantle release valve . Dismantle compressor D. Hand out sheets showing - . Types and components of guns . Types and components of air compressors . Types and components of spray booths.	A. Identify types of guns from hand out sheets. B. Identify components of . Guns . Compressors . Regulators C. Cleaning procedure of spray gun. D. Dismantle . Gun . Compressor .Regulator	Oral or Written A. Identify types of spray guns B. Identify components of - . Spray guns . Compressors . Regulators C. Explain spray gun cleaning procedure. D. Explain purpose of pressure release valve. E. Explain causes of - . Compressor knock . Compressor heats up . Operates longer than normal . Compressor pumps oil F. Define paint booth and explain the difference between the two types - G. List five safety procedures used when operating painting equipment.

Title - AGRICULTURAL MACHINERY PAINTING

OBJECTIVES BY UNIT	CONTENT
	. Air compressor (continued) . size compressor required . compute displacement . volumetric efficiency . components of compressor . intake and exhaust valves . cylinder . crankcase . crankshaft . air filter . automatic unloader . automatic pressure switch . motor protection . components of compressing outfit . types of motors . electric . gasoline . pressure release valves . installation of compressing outfit . operational malfunctions . compressor knock . compressor heats up . operate longer than normal . compressor pumps oil . Respirators . definition of . type of . hood . absorbing . dust type with filter . Spray booths . types . dry type . air washer type . reasons for spray booth . exhaust fans . types . booth maintenance . reason for . dry type maintenance procedure . air washer maintenance procedure

AGRICULTURAL MACHINERY PAINTING - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES

Code 01.0305-04

Title - AGRICULTURAL MACHINERY PAINTING

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Preparation of Machine to be painted Objective 3 - Prepare and adjust the equipment to properly operate painting equipment to obtain satisfactory results.	A. Preparation . Hook up hoses . Adjust regulator . Mix paint to proper consistency . Adjust Suction feed B. Properly hold gun C. Proper spray stroke . Flat surface . Corner Spray D. Undesirable results . Orange peel . Surface streaks . Runs or sags . Excessive mist or fog . Starving the gun E. Touch up procedure . Clean surface . Sanding - . feather edges . Application of finest coat
Unit 4 - Selecting proper paint and preparing for application Objective 4 - Make a proper paint and thinner selection and prepare it for application.	A. Primers B. Enamels C. Lacquers D. Thinners and solvents . Types of . Paint type used with . Storage procedures E. Mixing F. Thinning G. Straining

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Demonstrate - A. Mixing paint to proper consistency B. Hook up equipment C. Adjusting regulator D. How to hold gun E. Making Proper strokes F. Spraying flat surfaces G. Spraying corners H. Preparing spot painting	A. Mix paint to proper consistency. B. Actually hook up and adjust equipment. C. Hold and make proper strokes D. Actually paint flat and corner surfaces. E. Actually paint a small spot (touch up).	Properly hook up equipment for painting.
Lecture - Slides & Overhead - Actual paint and thinner A. Properties of Enamel vs. lacquer. B. Properties of thinner for enamel and lacquer. C. Methods of proper mixing and thinning. D. Method of straining paint prior to painting.	Compare lacquer with enamel. Apply incompatible thinner to lacquer. Apply incompatible thinner to enamel. Apply enamel over lacquer primer. Mix both enamel & lacquer to proper consistency.	A. Mix paint to proper consistency. B. Explain reason for straining paint before putting into gun. C. Reason for using compatible thinner and primer.

Code - 01.0305-04

Title - AGRICULTURAL MACHINERY PAINTING

OBJECTIVES BY UNIT	CONTENT
Objective 5 -Properly prepare the machinery for applying primer and paint.	A. Removal of parts for thorough application B. Steam Clean C. Sand blasting D. Sanding . Wet . Dry E. Masking
Unit 6 - Applying paint, trim and decals Objective 6 - Apply trim and decals at the proper time for maximum adherence.	A. Wheels B. Stripping C. Decal . Wet type . Dry type

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Lecture - Discussing A. Removal of components for good paint application B. Removal of dirt, oil and foreign material. C. Sand blasting to clean surface. D. Demonstrate - . Sanding . Masking	A. Prepare a machine for painting. B. Sand flat surfaces using wet and dry sand paper. C. Mask off components re. gauges, wires, electrical components.	A. Prepare a machine for painting . Removal of components. . Cleaning . Masking
Demonstrate application A. Stripping B. Decal kit	A. Actually strip B. Actually apply decal kit . Dry . Wet	

MODULE OF INSTRUCTION

Title - AGRICULTURAL MACHINERY PAINTING　　Code - 01.0305-04

RESOURCE MATERIALS

A. Books - Spray Painting Industrial and Commercial, F.M. Crewdson
Frederick J. Drake & Co., 7312 N. Ridgeway Ave.
Skokie, Illinois 60076, 1957

B. Bulletins - "How To" Booklets - National Paint, Varnish and
Lacquer Associations, Inc.
1500 Rhode Island Ave., N.W.
Washington, D. C. 20005

C. Periodicals -

D. Audiovisuals - Motion Picture

Spray Painting - De Vilbiss

MODULE OF INSTRUCTION

Title - PLANNING, LAYOUT, AND FABRICATION OF CUSTOM EQUIPMENT
Code - 01.0306-01

DESCRIPTION:

Shop modification of agricultural equipment, and the construction of simple equipment to meet special needs will be the activities in this module. Analysis of special problems and the making of sketches and layouts included will be welding, cutting, drilling, and other machine operations. Try out and modification of the finished product will be used in testing the job.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	 Other
1. Develop possible solution	2	
2. Sketch the idea on paper		2
3. Make, build, assemble, or construct		24
4. Demonstrate the workability of the finished product.		2
	2	28

Revised June, 1974

MODULE OF INSTRUCTION

Title - PLANNING, LAYOUT, AND FABRICATION OF CUSTOM EQUIPMENT

Code - 01.0306-01

OBJECTIVES to be obtained:

The student will be able to:

1. Work out a possible solution to the problem.
2. Sketch out his idea of that solution.
3. Make, build, assemble, or construct the necessary alteration or fabrication.
4. Demonstrate the workability of the finished product.

Title - PLANNING, LAYOUT, AND FABRICATION OF CUSTOM EQUIPMENT

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Develop possible solution Objective #1 Work out a possible solution to the problem.	A. Content depends on circumstances, problems to be solved and the discretion of the instructor. B. Example - adapting one type hitch (3 pt.) to another type (2 pt.). C. Example - adapting a hydraulic principle to a load leveling device. D. Example - fabricating a replacement part for an implement where a new part is unavailable or too time consuming otherwise.
Unit 2 - Sketch the idea on paper Objective #2 Sketch out his idea of that solution.	A. See #1 B. Simple drafting C. Cost and time estimates.
Unit 3 - Make, build, assemble, or construct Objective #3 Make, build, assemble, or construct the necessary alteration or fabrication.	A. See #1
Unit 4 - Demonstrate the workability of the finished product. Objective #4 Demonstrate the workability of the finished product.	A. See #1

EDUCATION

01.0306-01 - Code

PLANNING, LAYOUT, AND FABRICATION OF CUSTOM EQUIPMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Demonstration. B. Problem solving.		
Demonstration	Drawing of sketch of idea.	
Demonstration	A. Produce necessary materials. B. Perform necessary tasks to do the job.	
See #1	Try out the finished product and make any necessary changes so it will produce the desired result.	A. The instructor will have to evaluate the student on the basis of how well the finished product solves the problem. B. He can determine how much of the solution to the problem the student provided and how much he had to guide him. C. He can evaluate the workmanship and time necessary to do the job. He will have to determine if they meet his standards.

MODULE OF INSTRUCTION

Title - PLANNING, LAYOUT, AND FABRICATION OF CUSTOM EQUIPMENT

Code - 01.0306-01

RESOURCE MATERIALS

MODULE OF INSTRUCTION

Title - ELECTRICAL FUNDAMENTALS FOR AGRICULTURE Code - 01.0307-01

DESCRIPTION:

Wiring systems studied in this module will include those used on a farmstead, in a greenhouse complex, in an agricultural equipment dealership, or a residence. Laboratory exercises will give the student experience in wiring simple circuits. He will select the components to use and install them in a circuit for central lighting, heating, and motor loads. Standards of the National Board of Fire Underwriters will be adhered to.

Malfunctioning circuits will be studied to enable the student to locate the component that is malfunctioning and determine if he can fix it or if an electrician should be called.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations	
	Class	Other
1. Making electrical measurements	1	4
2. Understanding the electrical distribution system	1	3
3. Installing simple circuits	1	7
4. Selecting control devices	3	6
5. Troubleshooting a malfunctioning circuit	1	3
	7	23

Revised August 1975

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MODULE OF INSTRUCTION

Title - ELECTRICAL FUNDAMENTALS FOR AGRICULTURE Code - 01.0307-01

OBJECTIVES to be obtained:

The student will be able to:

1. Demonstrate measuring volts and amperes in an electric circuit using the "snap around" type volt ammeter. He will explain the meaning of the terms volts and amperes.
2. Demonstrate the relationship between volts, amperes, and watts in resistance and motor circuits using the "snap around" volt ammeter and a watt meter.
3. Trace the path of current from a pole transformer to a given outlet and explain the function of each component in the circuit.
4. Install a circuit containing a single pole switch used to control a light, using metal boxes and type UF cable. He will properly ground the boxes according to the National Electrical Code.
5. Install a circuit containing two three-way switches controlling a light, using metal boxes and type UF cable. He will be able to ground the boxes according to the National Electrical Code.
6. Install a grounded duplex receptacle using a metal box and type UF cable, properly grounding the box and the receptable according to the National Electrical Code.
7. Install male and female connectors to make a grounded extension cord, using three conductor type S service cord.
8. Select the proper size and type cable to use for the circuit when given a specific motor size or electric heat load at a specific distance from the service entrance.
9. Specify the type and size protective device to be used, given a specific electric load in a circuit and the size of cable used.
10. Specify the type of motor control devices needed to give the desired manual or automatic control of the motor, given a specific electric motor application.
11. Troubleshoot a circuit that does not work. Using the "snap around" volt ammeter or test light, he will identify the part of the circuit that does not work and determine whether he can fix it or if an electrician should be called.

Code - 01.0307-01

Title - ELECTRICAL FUNDAMENTALS FOR AGRICULTURE

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Making electrical measurements	
Objective 1 Demonstrate measuring volts and amperes in an electric circuit using the "snap around" type volt ammeter. He will explain the meaning of the terms volts and amperes.	A. Electrical terms . Volt . Ampere . Ohm . Watt
Objective 2 Demonstrate the relationship between volts, amperes, and watts in resistance and motor circuits using the "snap around" volt ammeter and a watt meter.	B. Use of electric meters . "Snap around" type volt ammeter . Watt meter
Unit 2 - Understanding the electrical distribution system	
Objective 3 Trace the path of current from a pole transformer to a given outlet and explain the function of each component in the circuit.	A. Service drop B. Meter location C. Feeders D. Branch circuit . General . Motor E. Overcurrent protection . Circuit breaker . Regular fuse . Time delay fuse

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Use reference material to define the terms and their interrelationship.	A. Build a circuit board with 3 sockets in series and 3 sockets in parallel. Using cone heaters in the sockets, demonstrate the relationship of voltage, amperage and resistance in parallel and series circuits. B. Using a 100 foot run of 12 gauge wire and a 100 foot run of 18 gauge wire, demonstrate voltage drop and its effect on light and heat output C. Using the "snap around" volt ammeter and a watt meter, demonstrate the relationship between volts, amps, and watts for heat loads, lighting loads and motor loads.	A. Give written test asking students to define terms and answer questions about their interrelationships. Evaluation on use of meters can be done by asking them to check actual circuits with meters.
A. Use overlays on an overhead projector to show the distribution of electricity on: . Dairy farmstead . Dairy barn . Milk house . Greenhouse complex . Individual greenhouse . Residence B. Use bulletins and references C. Show diagrams and cutaways of circuit breaker, time delay fuse, and regular fuse	A. Using the circuit board, demonstrate small and large overloads and have students record the time necessary for the overcurrent protective devices to trip. B. Field trip to a farm and a greenhouse complex where students sketch the location of distribution lines on a layout map and they record type of protective device used in each location.	A. Students sketch the electric distribution system on their home farm, greenhouse complex, farm supply store, or agricultural equipment dealership

Code - 01.0307-01

Title - ELECTRICAL FUNDAMENTALS FOR AGRICULTURE

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Installing simple circuits Objective 4 Install a circuit containing a single pole switch used to control a light, using metal boxes and type UF cable. He will properly ground the boxes according to the National Electrical Code. Objective 5 Install a circuit containing two three-way switches controlling a light, using metal boxes and type UF cable. He will be able to ground the boxes according to the National Electrical Code. Objective 6 Install a grounded duplex receptacle using a metal box and type UF cable, properly grounding the box and the receptacle according to the National Electrical Code. Objective 7 Install male and female connectors to make a grounded extension cord, using three conductor type S service cord.	A. Electrical safety B. Wiring materials and their use . Cable . NM (Romex) . NMC . UF . AC (BX) . service entrance cable . EMT . Size of conductor to use . Boxes . types . grounding . Outlets . light . duplex receptacles for 120 and 230 volts
Unit 4 - Selecting control devices Objective 8 Select the proper size and type cable to use for the circuit when given a specific motor size or electric heat load at a specific distance from the service entrance. Objective 9 Specify the type and size protective device to be used, given a specific electric load in a circuit and the size of cable used. Objective 10 Specify the type of motor control devices needed to give the desired manual or automatic control of the motor, given a specific electric motor application.	A. Manual controls for heating, lighting, and motor loads . Safety switches . Circuit breakers . Manual motor starter . Magnetic starter with push button control B. Automatic controls . Pressure switch . Thermostat . Humidistat . Time clock . Mechanical limit switch . Time delay relay . Photo relay

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Discuss National Electrical Code, local code, licensing of electricians, and electrical inspection. Have an inspector speak to the class if possible . Study National Electrical Code concerning types of cable and their use . Study National Electrical Code to determine proper size of overcurrent protective device for various conductor sizes . Study Farmstead Wiring Handbook concerning conductor size and voltage drop B. Demonstrate proper method of grounding metal boxes C. Demonstrate hazards of ungrounded equipment	A. Each student build a wiring board with 2 octagonal and 2 rectangular boxes and install the following circuits using UF cable . Single pole switch controlling one light . Single pole switch controlling two lights . Two three-way switches controlling a light . Two grounded duplex receptacles B. Each student can make a grounded extension cord using type S service cord C. On a suitable surface, install a fuse box or circuit breaker box and have students install lighting and receptacle circuits that involve running cables 10 feet or more, or actually wire a small building if available	A. Each exercise should be carefully inspected for proper connections and grounds before being energized. B. Written test on types of cable sizes and overcurrent protective device
A. Use overlays on overhead projector for type of control being taught B. Use manufacturers' catalogs to write specifications for electric control devices C. Use National Electrical Code, manufacturers' catalogs, and references to determine proper type and size components to use D. Discuss circuit protective devices in a circuit and the need for safe practices	A. Various manual and automatic controls can be hooked up and their operation studied B. Visit a farm or greenhouse complex to study the use made of control devices. Each student should record the type, make, model, size, and use of each control observed.	A. Determine an electrical control situation that the student might encounter in his chosen field of agriculture and have him prepare specifications for the controls he would use and then hook up those controls for testing.

OBJECTIVES BY UNIT	CONTENT
Unit 5 - Troubleshooting a malfunctioning circuit Objective 11 Troubleshoot a circuit that does not work. Using the "snap around" volt ammeter or test light, he will identify the part of the circuit that does not work and determine whether he can fix it or if an electrician should be called.	A. Systematic approach to troubleshooting B. Locating the malfunctioning component

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Discuss systematic approach	A. Demonstrate use of a test light to locate a blown fuse or tripped circuit breaker. B. Demonstrate use of a volt meter to locate a blown fuse or tripped circuit breaker. C. Use circuit boards to demonstrate the following malfunctions: . Grounded wire . Broken wire . Incorrect hook up	A. Set up circuits with malfunctions and have students locate them using a test light and "snap around" type volt ammeter. After the malfunction is identified, it should be corrected and the circuit tested.

MODULE OF INSTRUCTION

Title - ELECTRICAL FUNDAMENTALS FOR AGRICULTURE Code - 01.0307-01

RESOURCE MATERIALS

Books -

1. Electrical Terms, Athens, Ga., American Association for Agricultural Engineering and Vocational Agriculture, 1962
2. Farmstead Wiring Handbook, New York, Edison Electric Institute, 1965
3. Maintaining the Home Lighting and Wiring System, Athens, Ga., American Association for Agricultural Engineering and Vocational Agriculture, 1965
4. National Electrical Code, 1968 Edition, Boston, Mass., National Fire Protection Association, 1968 (Revised every 3 years)
5. Practical Electrical Wiring, 8th Edition, New York, McGraw-Hill Book Company, 1970

Bulletins -

1. Adequate Farm Wiring Systems, Cornell Extension Bulletin 849
2. Electric Motor Protection and Controls, Cornell Extension Bulletin 673

Periodicals -

1. Electricity on the Farm, Reuben Donnelly Corp., monthly, $2.50 per year
2. Farm Electrification, Edison Electric Institute, bi-monthly, $2.00 per year

Audiovisuals -

1. Suggestions for Teaching Electrical and Basic Controls Used in Agricultural Production, Edison Electric Institute, handbook and transparencies for overhead projector; homemade transparencies on farm layout, dairy farm, greenhouse complex, individual greenhouse and residence

MODULE OF INSTRUCTION

Title - USING ELECTRICITY IN AGRICULTURE Code - 01.0307-02

DESCRIPTION:

The student will learn how to select units for using electricity in agriculture for heat, light, and mechanical power. Students will be involved with selection of motors for specific purposes as well as maintenance procedures. Students will also be exposed to uses of electricity in heating. This will include maintenance of equipment, selection of equipment, and application of equipment. Selection and maintenance of proper lighting equipment will involve each student in appropriate activities.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Selecting and maintaining electric motors	8	4
2. Selecting and maintaining electric heat units	4	3
3. Selecting and maintaining lighting equipment	5	6
	17	13

Revised August 1975

MODULE OF INSTRUCTION

Title - USING ELECTRICITY IN AGRICULTURE Code - 01.0307-02

OBJECTIVES to be obtained:

The student will be able to:

1. Select the proper type and size electric motor for a specific application
2. Install an electric motor in a specific application with the belt correctly aligned and tightened and the electrical connections correct for voltage and direction of rotation
3. Demonstrate proper procedure for cleaning an electric motor
4. Replace motor bearings
5. Compare the costs of various types of energy for heating purposes
6. Know when to select electric heating units for a specific application by himself and when to obtain expert advice in selecting electric heating units
7. Maintain various types of electric heating equipment
8. Measure light intensity using a light meter and determine if an area is properly illuminated
9. Select the correct type, size, and number of luminaires to adequately light a specific area
10. Maintain lighting equipment for maximum light output

Code - 01.0307-02

Title - USING ELECTRICITY IN AGRICULTURE

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Selecting and maintaining electric motors Objective 1 Select the proper type and size electric motor for a specific application	A. Selecting a motor for a specific application considering: . Starting torque requirements . Horsepower . Speed . Voltage available . Single or three-phase . Enclosure required . Mounting required
Objective 2 Install an electric motor in a specific application with the belt correctly aligned and tightened and the electrical connections correct for voltage and direction of rotation	A. Installing electric motors . Voltage . Correct direction of rotation . Belt alignment . Belt tension
Objective 3 Demonstrate proper procedure for cleaning an electric motor Objective 4 Replace motor bearings	A. Maintaining electric motors . Lubrication . Cleaning . Bearing replacement . sleeve bearings . ball bearings

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Use filmstrip How Farm Electric Motors Start and Run to explain motor principles B. Use book Farm Electric Motors, Selection - Protection - Drives to study factors in motor selection C. Have students develop a plan for selecting a motor for a specific application on their farm, greenhouse complex, equipment dealership, or other agricultural business	Laboratory - Display different types of motors so students can see what they look like Field - Students make a survey of motors used on home farm, greenhouse complex, machinery dealership to determine size and type of motors used for various applications	A. Open book test, given information regarding equipment required for specific applications, select the proper types and sizes of electrical motors that would operate efficiently and economically. B. Electrical motor identification test. C. Laboratory exercise quiz.
A. Use Farm Electric Motors to explain installation B. Use motor nameplates and instructions to explain voltage and rotation direction connections	Laboratory - Students hook up various types and sizes of motors for 120 and 240 volts and both directions of rotation. The instructor should check hook up before energizing the circuit. Students install a motor on a piece of equipment in the laboratory with belt correctly aligned and tensioned.	A. Performance grade on laboratory exercise. B. Oral quiz on installing electric motors. C. Written test on voltage, alignment of motors, belt tension, and information on motor nameplates.
A. Use Farm Electric Motors B. Use motor instruction manuals and nameplates to determine lubrication recommendations C. Use catalogs to determine procedure for ordering motor bearings	Laboratory - Students clean and lubricate motors on equipment in the laboratory. Students bring in motors for cleaning and lubricating. Demonstrate replacing various types of bearings and have students participate as much as possible Field - Students clean and lubricate motors on the home farm, greenhouse complex, machinery dealership or other agricultural business.	A. Written test on maintaining electric motors. B. Performance test on laboratory exercises.

Code - - 01.0307-02

Title - USING ELECTRICITY IN AGRICULTURE

OBJECTIVES BY UNIT	CONTENT
Unit 2 - Selecting and maintaining electric heat units Objective 5 Compare the costs of various types of energy for heating purposes	A. Comparison of alternative heat sources (electric, gas, fuel oil) . Cost of installation . Cost of operation . Convenience . Maintenance required
Objective 6 Know when to select electric heating units for a specific application by himself and when to obtain expert advice in selecting electric heating units	A. Selecting electric heat units . Chick brooding . Milking parlor . Space heaters . Water heating . Other
Objective 7 Maintain various types of electric heating equipment	A. Maintaining electric heating units

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Discuss comparative costs obtained from power company, gas company, oil dealer. B. Use speakers from power company, gas company, fuel oil dealer.	Notes on discussion and guest speakers. Report on electrical and heating cost for home farm, cooperative farm, or Agri-business facility, monthly or annual costs.	A. Notebook grade B. Student report grade C. Written essay question on Objective 5.
A. Use manufacturers' literature to study makes, models, and size of equipment available. B. Have speaker from power company or electric heating contractor explain equipment available and procedures for selecting units C. Use Cornell Agricultural Engineering Bulletins #342, 304 and Farm Electrification Notes #4-68. D. Have students develop a plan for providing heat for a specific area of their farm, greenhouse complex, equipment dealership, or other agricultural business.	Laboratory - Display sample of different types of electric heat units. Field - Field trip to buildings that have electric heat to observe installation and learn of its effectiveness.	A. Field trip report B. Laboratory-exercises written and oral on a student plan for providing heat for a specific area, facility, equipment, or business.
A. Use manufacturers' literature for instruction on maintaining heat units.	Field trip to learn how owners maintain electric heat units	A. Field trip report B. Written quiz on maintaining electrical heating units.

OBJECTIVES BY UNIT	CONTENT
Unit 3 - Selecting and maintaining lighting equipment Objective 8 Measure light intensity using a light meter and determine if an area is properly illuminated	A. Selecting lighting equipment . Light requirements . Luminaires available
Objective 9 Select the correct type, size, and number of luminaires to adequately light a specific area	A. Installing lighting equipment . Mounting method . Mounting height . Controls
Objective 10 Maintain lighting equipment for maximum light output	A. Maintaining lighting equipment . Cleaning . Replacing fluorescent starters and ballasts

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Use the following references to determine light requirements: . ASAE Recommendations R286 . Illuminating Engineering Society paper CP-33 . Farm Electrification Notes #5-68 . Farm Electrification Notes #3-68 . Illuminating Engineering Society paper CP-36 . Illuminating Engineering Society Lighting Fundamentals Course - ED-2 B. Have students develop a plan for providing adequate lighting on their home farm, greenhouse complex, farm equipment dealership, or other agricultural business	Laboratory - Demonstrate the use of the light meter. Demonstrate factors involved in lighting, such as intensity, color, reflection. Demonstrate various types of luminaires. Field - Field trips to well lighted farm, greenhouse complex, equipment dealership, or other agricultural business.	A. Performance test B. Field trip report grade. C. Laboratory exercise test.
A. Use manufacturers' recommendations and the references listed above to determine proper installation B. Review controls studied in Unit 4 and circuits studied in Unit 3 of Electrical Fundamentals module.	Laboratory - Demonstrate effects of mounting height on the amount of light provided. Field - Study mounting methods and controls on field trip listed above.	A. Given a specific situation and area have students select the correct type, size and number of luminaries required for adequate lighting. B. Laboratory quiz
A. Use manufacturers' recommendations for maintaining lighting equipment.	Laboratory - Demonstrate light output of dirty light sources compared with clean ones. Demonstrate effects of defective starters and ballasts and have students replace them.	A. Laboratory exercise quiz. B. Performance evaluation in shop setting.

MODULE OF INSTRUCTION

Title - USING ELECTRICITY IN AGRICULTURE Code - 01.0307-02

RESOURCE MATERIALS

A. Books -

Farm Electric Motors, Selection - Protection - Drives. American Association for Agricultural Engineering and Vocational Agriculture, 1964, Athens, Georgia

IES Lighting Fundamentals Course - ED-2. Illuminating Engineering Society, 1960, New York

B. Bulletins -

Bulletin 304 - Heating Water Electrically for the Dairy Farm. Cornell Agricultural Engineering Department

Bulletin 342 - Milking Parlor Heating Methods. Cornell Agricultural Engineering Department

Farm Electrification Notes #4-68 - Principles of Infrared Heating. New York Farm Electrification Council

Recommendations R 286 - Lighting for Dairy Farms. American Society of Agricultural Engineers

Paper CP-33 - Lighting for Dairy Farms. Illuminating Engineering Society

Paper CP-36 - Lighting for the Poultry Industry. Illuminating Engineering Society

Farm Electrification Notes #3-68 - Outdoor Lighting of the Farmstead. New York Farm Electrification Council

Farm Electrification Notes #5-68 - Dairy Farm Lighting. New York Farm Electrification Council

C. Periodicals -

Electricity on the Farm - Reuben Donnelly Corp., Monthly, $2.50 per year

Farm Electrification - Edison Electric Institute, Bi-monthly, $2.00 per year

D. Audiovisuals -

How Farm Electric Motors Start and Run. American Association for Vocational Instructional Materials

MODULE OF INSTRUCTION

Title - MANAGING DEALERSHIP PARTS DEPARTMENT   Code - 01.0308-01

DESCRIPTION:

This module is designed to acquaint the student with the complex duties of a dealership parts department. He will become involved with inventory controls, the ordering and receiving of emergency and stock parts, marketing and advertising parts sales and learning the needs and problems of the agricultural dealership customers. The student will recognize the importance of the activities of the parts department and how they are dependent upon management and the service department. These activities will also coincide with the needs of the consumer.

DIVISIONS OR UNITS OF CONTENT	Time Allocation	
	Class	Other
1. The Role and requirements of a parts man	1	1
2. Inventory controls	2	3
3. Ordering Procedure	2	3
4. Receiving, checking and verification	1	3
5. Merchandising program	2	4
6. Effective Displays	1	4
7. Advertising	1	2
	10	20

Revised June, 1974

MODULE OF INSTRUCTION

Title - MANAGING DEALERSHIP PARTS DEPARTMENT Code - 01.0308-01

OBJECTIVES to be obtained:

The student will be able to:

1. Compare the important role of the parts man with the other personnel in the total dealership operation.
2. Compare the personal characteristics required of a parts man with the other personnel in the total dealership operation.
3. Identify inventory control procedures, and compare good control practices with haphazard controls.
4. Efficiently order parts from a manufacturer using varied order forms required by them.
5. Efficiently receive, check in parts shipment, record back orders, file damage reports and file all documents for future reference.
6. Identify the need of promoting parts sales and formulate a parts merchandising program for one year period.
7. Effectively utilize available display areas by designing promotional sales of parts and recognize the need for effective displays.
8. Develop an effective advertising program for a one year period for a dealership.

Code - 01.0308-01

Title - MANAGING DEALERSHIP PARTS DEPARTMENT

OBJECTIVES BY UNIT	CONTENT
Unit 1. - The Role and requirements of a parts man Objective 1. - Compare the important role of the parts man with the other personnel in the total dealership operation.	A. Parts sales and total sales relationship. . Margin per dollar . Percent of sales . Return above costs B. Parts department and other department relations . Parts records of customer sales . Service department . New and used machinery sales . Customer confidence and respect . Parts department management and customer retention. C. Basic duties of a partsman . Keep adequate supply of fast-selling parts . Estimate future parts needs and order. . Check and store incoming parts. . Advertise and display parts. . Sell parts, collect and account for money involved.

01.0308-01 - Code

MANAGING DEALERSHIP PARTS DEPARTMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
		Oral or Written
A. Have a dealership manager and a dealership partsman talk to class.	A. Calculate margin	A. Calculate % of parts sales vs. total sales
B. Lecture with use of slides and/or transparencies	B. Visit successful dealership to observe . Records of customer sales . Relationship & records of sales to service dept. . Records maintained on new and used equipment. .Records for inventory control.	B. Develop records for parts sales to . Customer . Service department . Used and new machinery
C. Show figures concerning margin of successful business.	C. Use of communication media-advertisement samples.	C. Develop a method of keeping inventory.
D. Show equipment association figures of percent parts sales vs. total sales.	D. Use parts books	D. Develop seasonal advertising program
E. Show sample records for - . Service department sales . New and used machinery sales . Inventory cards	E. Use of parts inventory file, parts storage, etc.	E. Order parts required for specific repair
F. Use of states dealership association information.	F. Use telephone ordering parts from supplies.	F. Check in parts received . Record back orders
G. Use sample record cards from successful dealership . Method of record of fast moving parts. . Sales history over period of years.	G. Use telephone receiving orders from irate customer.	
H. Use sample manufacturer's shipping slips. . Check in parts received . Record back orders		
I. Use repair parts lists order parts for specific repair.		
J. Use of phone - talking to customers.		

Code - 01.0308-01

AGRICULTURAL

Title - MANAGING DEALERSHIP PARTS DEPARTMENT

OBJECTIVES BY UNIT	CONTENT
Objective 2 - Compare the personal characteristics required of a parts man with the other personnel in the total dealership operation.	A. Basic knowledge needed by partsman . Parts . Machines . Operating & management procedures . Farming methods and problems . Know how farmers think B. Personal Characteristics . Patient . Steady . Impartial . Responsive . Diplomatic . Good Housekeeper . Good teacher . Good observer . Ambitious learner C. Job requirements . Keep good written records . Report prospective buyers . Report customer complaints . Compare yearly purchases and sales . Keep parts inventory . Know transportation and communication expenses . Know parts turnover . Know customer financial status.

EDUCATION

01.0308-01 - Code

MANAGING DEALERSHIP PARTS DEPARTMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Lecture - Using slides and/or overhead showing . Cutaway - . Parts illustrations	A . Use parts Books B . Parts ordering procedures	
Lecture - using slides or overhead showing - . Good listener . Diplomacy . Good Housekeeping . Understanding of problem from description . Accurate account of customer requirements	Set up mock conversation between each two students. One a customer of various temperament, the other the local dealer parts man. . Customer has an assimulated problem. . Customer has written exact problem on paper. . Customer tells parts man problem - compare problem told to parts man with actual problem.	Oral - A. Record problem - B. Have a student act as customer with a specific problem. C. Have others in class act as parts man recording problem . Actual problem . Required parts needed.
Lecture - using slides or overhead showing - . Sample inventory records . Sample reports of prospective buyers and customer complaints. . Sample inventory cards . Sample transportation cost chart . Keep records of parts turnover and importance of	A . Fill out prospective buyer reports. B . Fill out customer complaint form. C . Figure out shipping costs of incoming shipments.	Visit dealership & obtain - . Sample prospective buyer forms . Sample customer complaints form . Sample inventory cards . Explain how each work and what information is required.

Code 01.0308-01

Title - MANAGING DEALERSHIP PARTS DEPARTMENT

OBJECTIVES BY UNIT	CONTENT
Unit 2 - Inventory controls Objective 3. - Identify inventory control procedures, and compare good control practices with haphazard controls.	A. Efficient stock parts keeping . Smaller stock-less capital investment . Balance of obsolete and fast moving parts. . Speeds up receiving and stocking-reduces errors. . Errors of judgement in ordering less drastic. B. Inventory control record cards show: . Machine used on . Substitute part number . Part replaced . Order number & date . Quantity ordered . Date order received . Quantity sold . Description of part . Part number . Inventory on hand
Unit 3 - Ordering Procedure Objective 4 - Efficiently order parts from a manufacturer using varied order forms required by them.	A. Part numbering . Positive identification . Speeds up service . Significance of a part number B. Parts Catalogues C. Ordering Steps . Correct part number . Check parts catalog . List correct part number . List in numerical sequence . Make inventory card entry . Identify type of order . stock order . emergency order . fill-in order . special merchandising order . quantity discount order

01.0308-01 - Code

MANAGING DEALERSHIP PARTS DEPARTMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Lecture using slides & overhead showing - . Figures on efficiency . Manufacturer repurchase of obsolete parts programs . Recommended reorder procedures. . How to determine fast moving parts. . Records on ordering parts. . Running inventory cards. . Part numbers and their substitutions.	A. Using sample want sheets have students record parts to order. B. Obtain obsolete dealer inventory cards, determine if fast moving. C. Obtain running inventory cards, fill out upper portion of card. D. Design code for - . Obsolete parts . Fast moving parts . Ordered parts after supply depletion . Back orders . Substitution numbers	Work with local dealership - . Select 50 items by part number . Maintain one year movement of part selected. . Previous year movement. . Parts ordered - quantity & date . Date received . Back orders . Catagorize as . fast moving . slow moving . obsolete
A. Set up sample parts order and demonstrate use of parts catalogues to complete order forms. B . Using manufacturers parts list, review contents. C. Fill out machinery company odering forms. D. Slides, overhead or opaque show and discuss - . Ordering procedure . Inventory cards . Stock order . Merchandising order form . Discount structure	Part catalog use, ability to order parts correctly. . Complete - . daily parts order . seasonal stock order . yearly stock order . Calculate discounts available.	Written Quiz . Make an emergency order for parts for a broken machine using parts catalog and parts ordering form. . Make a regular stock order for inventory. . Make a seasonal stock order and determine method of shipment.

Code - 01.0308-01

Title - MANAGING DEALERSHIP PARTS DEPARTMENT

OBJECTIVES BY UNIT	CONTENT

Unit 4. Receiving, checking and verification
Objective 5 - Efficiently receive, check in parts shipment, record back orders, file damage reports and file all documents for future reference.
	A. Receiving a parts order
	. Inspection for damage
	. Check loading tally and freight bill for:
	  . number of item
	  . weight
	  . name, address, ship-to code
	. Note shortage or damage on freight bill before signing
	. Retain dealer's copy of freight bill and give to correct bookkeeper.
	B. Damaged shipment
	. Inspect damage and notify carrier
	. Estimate damage in dollars and cents
	. File damage claim
	C. Check contents and place in bins
	. Check contents against packing slip
	. Check inventory cards for bin location
	. Place parts in bin
	D. Post on inventory control cards
	. Post from packing slip
	. Up-date control cards
	. File packing slip
	. Any discrepencies in order should be reported to parts department.

Unit 5 - Merchandising program Objective 6 - Identify the need of promoting parts sales and formulate a parts merchandising program for one year period.	A. Efficiency of operation . Fact handling of customer . Parts display - self service . Efficient use of space . Control stock size B. Tools of selling . Displays . Advertising . Sales of service shop work . Telephone . Promotion of early repair . Sell related parts . Sell accessories . Sell toys . Sell improvement and changeover packages . Flat-rate pricing and estimating C. Sell to serve the customer best. . Correct machine usage . Preventive - maintenance

01.0308-01 - Code

MANAGING DEALERSHIP PARTS DEPARTMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Use slides, overhead - discuss the use of parts orders to explain content. Obtain and explain use of: . Freight billing forms . Packing slips . Invoice forms . Loss and damage claim forms . Bill of lading	A. Check parts order B. Check parts shipped C. Binning parts D. Correct use of forms . Fill out damage report . File freight bills, order forms, invoices . Post on inventory cards	Working with dealership - assist parts man . Check shipment against bill of lading. . Check for shortage & damages . If shortage and/or damage file claim form. . Post parts received on inventory cards . Check parts . received against orders.
Use slides, overhead - discuss - . Role play parts - selling. . List characteristics of salesmen good and bad. . Set up model displays. etc. . Stress importance of knowing machines for which parts are stocked and sold. . Merchandising literature from manufacturers. . show sample - . newspaper advertisements . hand bills . parts display racks (Self service)	A. Using a dealer display area . Design seasonal display . Permanent display B. Outline program for . Telephone sales . Seasonal advertising . Early order hand out sheets . Preventative maintenance	Working with dealership - . Outline a one year program - . Merchandising . Seasonal sales . Preventative maintenance Make a schematic of parts display area - . Show fast moving items. . Seasonal item display.

OBJECTIVES BY UNIT	CONTENT
Unit 6 - Effective Displays Objective 7 - Effectively utilize available display areas by designing promotional sales of parts and recognize the need for effective displays.	A. Means of selling parts . Impress the customer of dealers ability to supply parts. . Indicate extensiveness of parts supply . Inexpensive advertisement . Inspirational buying is promoted . Add to attractiveness B. Fundamentals of displaying . Feature rapid selling items . Coordinated with advertising . Easy access to customer . Area should be neat and clean . Timely display . Price information shown . Display checked and replenished daily . Good lighting . Some featuring and sequence should be apparent. C. Types of displays . Islands and tables . Boards . Windows . Floor . Wall . Counter and shelf D. Parts most effectively displayed . Seasonal parts . Parts with best sales margin . New items . Related parts and accessories

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
Check with dealerships to make up a chart which will indicate how important advertising is believed to be by management. Have an advertising staff member talk to class. Acquire examples of the various media.	A. Write up advertisements for six media's - make samples. B. Visit dealerships - obtain sample advertisements.	From dealerships visited obtain copies of revamped advertisements to move parts sales.

E D U C A T I O N

01.0308-01 - Code

MANGING DEALERSHIP PARTS DEPARTMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Slides of types of displays (good and poor procedures) B. Show arrangements, materials used to present parts of display. C. Discuss methods of display as related to particular parts being displayed. D. Discuss and illustrate types which lend themselves best for particular items of sale. E. Stress timeliness of display.	A. Visit other dealers for ideas. B. Build islands, counters & shelves for an effective display. C. Trips to area dealerships - compare displays.	Oral or Written . Make suggestions for improving display and promotional program of dealership working with. . Explain importance of changing and factors of effective displays. . Of Dealerships Visited - Redesign display to become more effective. . Set up various types of displays using parts which are most appropriate for the type chosen.

Code 01.0308-01

Title - MANAGING DEALERSHIP PARTS DEPARTMENT

OBJECTIVES BY UNIT	CONTENT
Unit 7 - Advertising Objective 8. - Develop an effective advertising program for a one year period for a dealership.	A. Importance of advertising . Reaches customers who do not frequent dealership. . Inform customers of new machines & part availability. . Increases desire for ownership of parts and accessories. . Influences customers to use service offerings of dealership. B. Media of advertising . Direct mail . Newspaper ads . Radio . Road signs . Television . Handbills C. Planning is most important in advertising

MODULE OF INSTRUCTION

Title - MANAGING DEALERSHIP PARTS DEPARTMENT Code - 01.0308-01

RESOURCE MATERIALS

A. Books - (text) Wilson, L. W. Farm & Power Equipment
Retailers Handbook, Nat. Farm Power Equip. Dealers Assoc.,
2340 Hampton Ave., St. Louis, Missouri, 1964

B. Bulletins -
1. John Deere Co., Syracuse, N.Y., Your Parts Department
2. Dealership Management Manual; Parts Management, Massey-Ferguson Co., Racine, Wisconsin
3. International Harvester Co., What is a Parts Number, Chicago, Illinois
Parts Sales Manual, John Deere Co. Inc., Maline, Illinois

C. Periodicals -
1. Newspapers
2. Farm Power and Equipment
3. Implement and Tractor

D. Audio visual aids -

MODULE OF INSTRUCTION

Title - MANAGING AN AGRICULTURAL MACHINERY SERVICE DEPARTMENT

Code - 01.0308-02

DESCRIPTION:

There are three departments in a well balanced agricultural machinery dealership -- service, sales, and parts. Each should make a profit for the dealer.

This module is designed to give a student some knowledge of managing an agricultural machinery dealer service department to make a profit for the dealer and protect customer investment.

In this module there are units of study on profit analysis, management control, flat rate, machine earnings, scheduling work, job tickets, pre-delivery and delivery service, service department layout, and foreman's desk and library.

MAJOR DIVISIONS OR UNITS OF CONTENT	Time Allocations Class	Time Allocations Other
1. Service department personnel	5	3
2. Service department layout and planning	3	4
3. Service record keeping	3	8
4. Special activities	2	2
	13	17

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MODULE OF INSTRUCTION

Title - MANAGING AN AGRICULTURAL MACHINERY SERVICE DEPARTMENT

Code - 01.0308-02

OBJECTIVES to be obtained:

Given a dealership service department situation the student will be able to:

1. describe the purposes of a farm machinery dealer service department
2. identify and explain the factors relating to management control
3. describe the organization of personnel in the service department and the role of each person at a level of performance acceptable to the teacher
4. draw up a floor plan for an efficient service department operation
5. describe the daily operation of a service department
6. completely and accurately fill out and price a shop service order, using a flat rate manual as a guide

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Title - MANAGING AN AGRICULTURAL MACHINERY SERVICE DEPARTMENT

OBJECTIVES BY UNIT	CONTENT
Unit 1 - Service department personnel	
Objective 1 Describe the purposes of a farm machinery dealer service department	A. Purposes of a farm machinery dealer service department . Protect the customer's investment . importance of pre-delivery service of equipment . importance of post-delivery service of equipment . importance of efficient troubleshooting and repairs . importance of service personnel training . Make a profit for the dealer . importance of daily and monthly individual service personnel records . importance of machine earning records . importance of computing a monthly profit analysis
Objective 2 Identify and explain the factors relating to management control	A. Management control . Product sold in a service department . How to set a reasonable goal on a monthly basis . Controlling time . use of time clock . use of time tickets . Computing efficiency of individual serviceman's time from time tickets and shop tickets . Methods of analyzing the quality of service . Shop and personnel appearance . Adequate shop tools . Proper use of service library

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
. Discuss the two major purposes and the importance of the contributing factors. (The contributing factors will be discussed in detail throughout this nit.)	A. Field trip to farm machinery dealership service department. While there: . Make rough sketch of shop floor plan . Note type of shop service order used . Note type of pre-delivery and delivery service orders (if used) . Study a pre-delivery service checksheet (if used) (These four items can be used for discussion in their respective units.)	A. Oral or written description of purposes given to instructor's satisfaction
. Discussion B. Use chalkboard and/or overhead projector to show types of time tickets and how to calculate and record time -- daily and monthly . Have students look up and record or recite a service procedure from the service library	A. Use service library to look up tools used and service procedure for a given job B. Use time tickets and time clock C. Calculate saleable time (recovered time) D. Understand duties of service personnel	A. Instructor assess students' understanding of controlling time, computing efficiency of individuals B. Identification test of shop tools C. Student description of use of individual items in service library

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OBJECTIVES BY UNIT	CONTENT
Objective 3 Describe the organization of personnel in the service department and the role of each person at a level of performance acceptable to the teacher	A. Personnel . There are two choices when hiring service department personnel: . hire inexperienced personnel and train them . hire experienced personnel . Ratio of experienced personnel to trainees . Ratio of servicemen to leadman (foreman) . Duties of service personnel . Duties of service foreman . Duties of service department manager . How to select service personnel B. Training . Why training service personnel is necessary . Possible methods of training service personnel . Available training, such as factory, local school evening courses, etc.
Unit 2 - Service department layout and planning Objective 4 Draw up a floor plan for an efficient service department operation	A. Service department layout . Floor plans . Aisle widths . Stall size for tractors, cleaning area, set up farm equipment, etc.
Objective 5 Describe the daily operation of a service department	A. Foreman's desk and library . Importance of a service foreman's desk and types . Items kept at or near the foreman's desk, such as: . service library . customers' machine service data records . Importance of a service library . How to fill out and file service data records . Keeping service data records up to date . Filing service information in the library B. Scheduling work . Use of a calendar pad to schedule work . Use of flat rate manual to schedule mechanic's time . Making forms to be used by sales department to inform service foreman of new and used machine delivery and pick-ups

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EDUCATION

MANAGING AN AGRICULTURAL MACHINERY SERVICE DEPARTMENT - Title

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Discussion B. Use a resource person, such as a farm machinery dealer, service department manager, or service foreman	A. Set up mock interviews for service jobs B. Fill out job application forms Skills: . understand duties of service personnel	A. Matching questions on personnel and descriptions of duties B. Instructor assess student's ability to complete job application C. Instructor assess student's interview techniques
A. Discussion	A. Have students list available training in their area, such as adult education courses, factory training at a dealership, etc.	A. Oral or written listing of training available
A. Discussion B. Use chalkboard and/or overhead projector to show and discuss mock floor plans	A. Make up mock floor plans for service department B. Rearrange the floor plan of a mock service department Skills: . service department layout consultant	A. Instructor assess students' floor plans
A. Discussion B. Use chalkboard and/or overhead projector to show types of service data cards and demonstrate how to fill them out and keep them up to date	A. Look up shop foreman's desks in sales catalogs, list advantages and disadvantages of different types B. Fill out service data sheet on a tractor in the shop C. Check proper filing of service information in the shop library Skills: . maintain service data records . file service information	A. Instructor assess accurateness of work done under student application activity
A. Discussion B. Use of flat rate manuals to look up time required to do a specific tractor repair (demonstrate) C. Use chalkboard or overhead projector to show how to make and fill out necessary forms	A. Look up time required to do specific repairs on a tractor B. Make up a calendar and schedule 1 week's work for 2 mechanics Skills: . how to schedule work to keep mechanics busy and show a profit on their time	A. Make up a service job on a specific make and model tractor. Have the student accurately and completely fill out a shop service order using a flat rate manual for labor prices

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OBJECTIVES BY UNIT	CONTENT
Unit 3 - Service record keeping Objective 5 Describe the daily operation of a service department Objective 6 Completely and accurately fill out and price a shop service order, using a flat rate manual as a guide	A. Job tickets . Importance of job tickets . Importance of having customers sign job tickets . Properly filling out a job ticket . Use of job ticket while job is in shop . Use of job ticket when job is completed . Filing job tickets after job leaves shop B. Parts department relations . Importance of the parts department and service department working together to: . maintain a stock of parts for future repairs . keep informed of latest changes in parts . increase parts sales . increase service sales . identify worn parts
Unit 4 - Special activities Objective 5 Describe the daily operation of a service department Objective 6 Completely and accurately fill out and price a shop service order, using a flat rate manual as a guide	A. Pre-delivery and delivery service . The value of a delivery report . Four important steps in making delivery: . receiving . warehousing and storage . preparing for delivery . delivering B. Selling service . Reasons for selling service . Methods of selling service . Shop conditions for selling service C. Flat rate . Advantages of a flat rate system . How to price a flat rate job . Keeping individual mechanic's records from flat rate records D. Machine earnings . The reason for, and value of, machine earnings . How to determine the hourly rate of a shop machine

TEACHING METHODS	STUDENT APPLICATION ACTIVITIES	EVALUATION PROCEDURES
A. Discussion B. Use overhead projector with transparency of a standard job ticket and fill it out completely using mock information. Each student should have a job ticket and follow the mock information.	A. Practice filling out and pricing a job ticket Skills: . properly fill out a shop service order (job ticket)	
A. Discussion	A. Locate and identify parts' numbers for machine and tractor parts	
A. Discuss and make up a pre-delivery and delivery report form B. Make up a pre-delivery check-sheet and use it on a machine or tractor in the shop. (Use information from previous field trip)		A. Instructor assess completeness of students' activity
A. Discussion and students' reports	A. Have students collect and service promotion advertisements from newspapers and circulars and report them to the class for discussion.	
A. Lecture and discussion B. Student reports	A. Have students price a flat rate job from a flat rate manual, such as I. & T. Flat Rate Manual	A. Provide students with a quiz using mock-up situation whereby they price a job
A. Use valve refacing machine as an example and make up hourly rate	A. Have students make up hourly rate for other machines in shop using different depreciation times	A. Instructor assess the students' figures for accuracy and practicality

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RESOURCE MATERIALS

1. Management Seminar, Avco New Idea Farm Equipment Division, Coldwater, Ohio
2. Farm and Power Equipment Retailer's Handbook, St. Louis, Missouri, National Farm and Power Equipment Dealers Association, 1964
3. Business Practices for Agricultural Dealers, Shop Service, Part 2, Columbus, Ohio, Ohio Agricultural Education Curriculum Materials Service, The Ohio State University, 1969, 160 pages

Audio-visual

1. Transparency of shop service order